Partnership for Nuclear Security

MPC&A Program

Strategic Plan

U.S. Department of Energy

January 1998

FOREWORD:

During the Cold War, the United States and the Soviet Union amassed vast stockpiles of plutonium and highly enriched uranium, the essential materials for nuclear weapons. For nations and terrorist organizations seeking to develop nuclear arms, acquiring these key materials is the most difficult step in manufacturing such weapons. Fortunately, in the past, the only means for states to obtain plutonium or highly enriched uranium was to build the facilities needed to produce and refine these materials, a process requiring many years and one that has been well beyond the capabilities of non-state organizations.

Today, however, there is growing concern that would-be proliferators might be able to obtain these materials by theft or diversion. The hundreds of tons of weapons-usable nuclear materials produced during the Cold War are enough for tens of thousands of nuclear devices. Stolen nuclear material could create potent new threats to U.S. allies and U.S. forces overseas, open new opportunities for national aggression and blackmail in the world's most volatile regions, or, threaten the U.S. homeland, itself.

These dangers underscore the importance of rigorous national and international efforts to improve nuclear material protection, control, and accounting (MPC&A) and to prevent nuclear material from entering the smuggling pipeline where it is difficult or impossible to retrieve.

The United States began MPC&A upgrades in the 1970s, following the terrorist events surrounding the Munich Olympics. Such upgrades have continued at DOE facilities since that time, and have resulted in generally very substantial security systems for DOE facilities. Although recent reports indicated that even more resources and attention must be paid to DOE facility protection requirements, we are continually analyzing and taking steps to improve our nuclear MPC&A in response to changing threats, while also seeking to responsibly manage associated costs, ensure public health and safety, and respect the environment. These upgrades are especially relevant to the current needs of nuclear facilities in the former Soviet Union to address changing threats and move toward more technology based MPC&A systems.

Prior to the end of the Cold War, the Soviet Union placed a high priority on nuclear material security mainly through large investments in "guards, gates, and guns." These Soviet-era systems for controlling nuclear materials were highly effective. In recent years, however, fundamental economic, political, and social changes in Russia, the Newly Independent States (NIS), and the Baltics have made it necessary to revise and update the MPC&A systems in these countries. During the Cold War's four decades, the United States and the Soviet Union worked separately on these problems, with little sharing of ideas, methods, or technologies. Now, for the first time, the United States, Russia, the NIS, and the Baltics are working together in a partnership for nuclear material security relying on technology-based MPC&A systems.

This partnership for nuclear material security is built upon new confidence and trust that has evolved between the United States and the states of the former Soviet Union. Nuclear experts from these countries are now cooperating to adopt effective MPC&A methods and technologies, as well as to develop comprehensive and self-sustaining MPC&A systems consistent with international standards. Significant progress has been made since this historic cooperation began in 1993, first to build trust and confidence and later to install fully operational MPC&A systems to improve security. However, much work remains to be done.

This Strategic Plan describes the Department of Energy's cooperative efforts with Russia, the NIS, and the Baltics to improve the security of weapons-usable nuclear materials that exists in forms other than assembled nuclear weapons. The plan establishes the strategies and schedules needed to complete the major goals of the MPC&A program by the end of 2002 and sets the stage for continued cooperation on nuclear material security in the 21st century.

Rose E. Gottemoeller, Director
Office of Nonproliferation and National Security
U.S. Department of Energy

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1944 - 1997

In memory of George Kuzmycz, respected friend and colleague, for his tireless dedication and work towards fulfilling the mission and goals of the MPC&A program. He will be greatly missed by all of us.

I. Program Mission

A. Need for Improved Nuclear Material Security

Problem and Its Magnitude

In the aftermath of the Cold War, the international community faces a common threat: the possibility that weapons-usable nuclear materials (plutonium [Pu] and highly enriched uranium [HEU]) could be stolen or diverted.[1] These materials are the essential ingredients of nuclear weapons. Loss of even small amounts of this dangerous material could enable additional states or a terrorist organization to build a nuclear weapon.

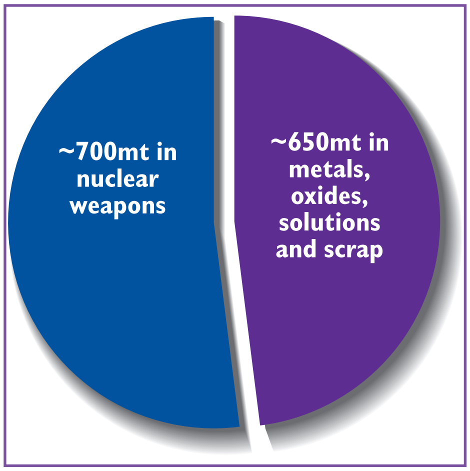


Figure 1. *Weapons-usable nuclear material in Russia, the NIS and the Baltic States.*

The threat posed by this material is most urgent in Russia, the NIS, and the Baltic states, which inherited weapons-usable nuclear material when the Soviet Union collapsed in 1991. Experts believe that the former Soviet Union produced more than 1,200 tons of HEU and 150 tons of Pu.[2] More than half of this material resides in assembled nuclear weapons. Because they are strictly accounted for, difficult to transport, and heavily guarded within secure military installations, assembled nuclear weapons are considered to be much less vulnerable to theft or diversion than weapons-usable nuclear materials in other forms.

Therefore, the greatest threat is presented by approximately 650 metric tons of weapons-usable nuclear material that exists in forms such as metals, oxides, solutions, and scrap.[3] This material, enough to produce more than 40,000 nuclear bombs, is spread among eight countries spanning eleven time zones. These materials are in use or stored at over 50 sites across Russia, the NIS, and the Baltics. (See Map on pages 10 and 11)

Causes

The nuclear material at these sites is vulnerable to theft because the security system that protected this material during the Soviet period has weakened due to political and economic upheavals in the region. The Soviet system was focused on preventing outsider threats. It relied heavily on the use of military guards and on constant surveillance of personnel by state security forces, such as the KGB. This "guards, guns, gates, and gulag" approach was very effective. Moreover, workers within nuclear facilities had little incentive to divert nuclear material because they enjoyed high wages, high social status, and other exclusive benefits.

The current economic crisis in Russia, the NIS, and the Baltics has destroyed the foundations of this system. Budget cuts have decreased the number and effectiveness of guard force personnel, security system maintenance activities, and operational readiness. In order to reduce costs and retain key scientific staff, many nuclear facilities have cut spending for nuclear material security systems. Many nuclear workers now live under difficult conditions because they have not received wages for long periods of time and because the quality of available food, housing, and medical care has declined. These circumstances increase the chance that "insider" personnel could be tempted to steal nuclear material for financial gain.

[1] In this report weapons-usable nuclear material is HEU enriched above 20 percent U235, and Pu not in irradiated fuel.

[2] Russia continues to produce approximately 2.5 metric tons of Pu per year that is being placed in storage.

[3] Confirmed estimates of the quantity of weapons-usable nuclear material in Russia, the NIS and the Baltics in forms other than weapons are not available. Approximations of this quantity can be found in several unofficial sources including: Oleg Bukharin, "Security of Fissile Materials in Russia," Annual Review of Energy Environment, vol. 2, (1996) and Graham T. Allison, et al. "Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material," CSIA Studies in International Security, no. 12, (MIT Press 1996).

Evidence

The overall decline of nuclear material security in Russia, the NIS, and the Baltics has been confirmed by visits of U.S. personnel to nuclear facilities in the region, reports in the media, and by official government reports. Specific MPC&A deficiencies existing at many nuclear sites in Russia, the NIS, and the Baltics include:

- lack of unified physical protection standards and inadequate defenses of buildings and facilities within the site perimeter fence (see Figure 2.)
- lack of portal monitors to detect fissile materials or weapons leaving or entering a site
- inadequate central alarm stations, alarm assessment and display capabilities
- inadequate protection of guards from small-arms fire and inadequate guard force communications
- lack of material accounting procedures that can detect and localize nuclear material losses
- inadequate measurements of waste, scrap, and hold-up nuclear materials during processing and of transfers of nuclear materials between facilities
- antiquated tamper-indicating devices (seals) on nuclear material containers that cannot guarantee timely detection of nuclear material diversion (see Figure 3.)

Figure 2. *Soviet-era fence in Russia.*

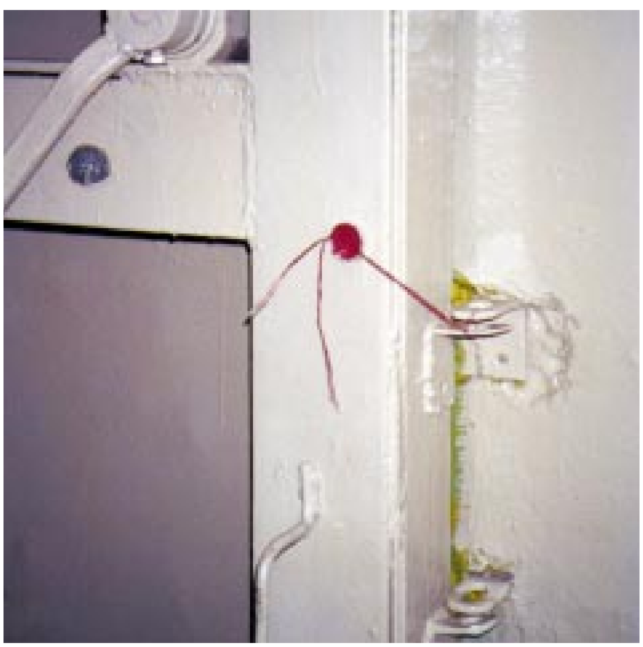


Figure 3. *Soviet-era wax and string seal on nuclear material in Russia*

Russian officials have reported two dozen incidents of theft and attempted theft of nuclear-related items, including several cases involving small quantities of weapons-usable nuclear material.[4] In addition, U.S. officials have confirmed seven smuggling incidents involving small amounts of weapons-usable nuclear material (see Timeline pg. 4). Although not confirmed in all cases, it is suspected that these materials were stolen from sites in Russia and the NIS. While the material involved in each of these incidents was recovered, they demonstrate that the theft of nuclear weapons is a real and continuing danger, with the potential to threaten U.S. and global security.

In order to reduce the nuclear proliferation risks associated with these new and evolving insider and outsider threats, facilities in Russia, the NIS and the Baltics, with U.S. assistance, have begun to install improved nuclear security systems that employ modern technology and strict material control and accounting principles.

[4] "Proliferation Concerns: Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union," National Academy of Sciences/National Research Council, April 1997.

B. The Role of MPC&A in Nuclear Material Security

Modern, well-designed nuclear MPC&A systems provide a cost-effective and reliable way of securing nuclear material from both insider and outsider threats. Improving MPC&A systems at sites where nuclear material is inadequately protected is a critical component of U.S. national security strategy because such improvements prevent nuclear material from entering the smuggling pipeline, where it is difficult or impossible to retrieve. MPC&A improvements thus provide the first line of defense against nuclear smuggling which could lead to nuclear proliferation or nuclear terrorism. Nearly all countries possessing nuclear materials have established MPC&A systems that are consistent with guidelines developed by the International Atomic Energy Agency (IAEA).[5]

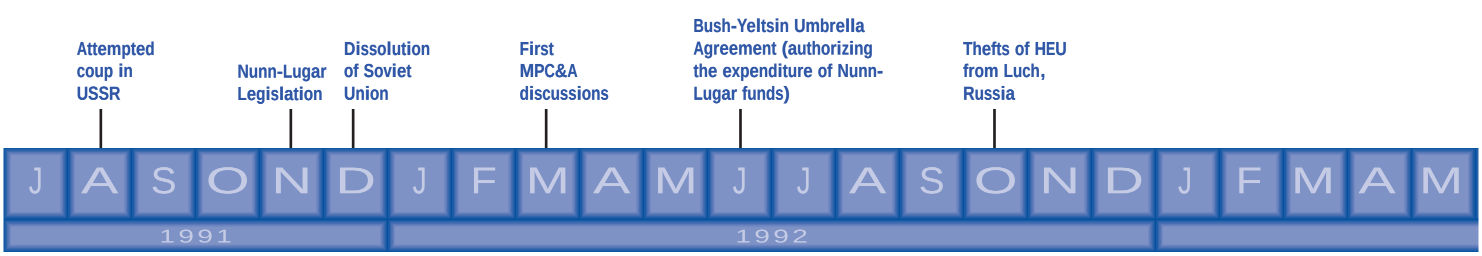
Over the years the United States has made major improvements to MPC&A systems at its nuclear facilities. In the 1960s, predictions of rapid growth in the commercial use of HEU and plutonium and high levels of material unaccounted for at some facilities prompted the U.S. Atomic Energy Commission to tighten regulations for nuclear material control and accounting. The United States began MPC&A upgrades in the 1970s, following the terrorist events surrounding the Munich Olympics. Such upgrades have continued at DOE facilities since that time, and have resulted in generally very substantial security systems for DOE facilities. Although recent reports indicated that even more resources and attention must be paid to DOE facility protection requirements, we are continually analyzing and taking steps to improve our nuclear MPC&A in response to changing threats, while also seeking to responsibly manage associated costs, ensure public health and safety, and respect the environment. These upgrades are especially relevant to the current needs of nuclear facilities in the former Soviet Union to address changing threats and move toward more technology based MPC&A systems.

Figure 4. *Demonstrations at U.S. nuclear facilities*

Major components of modern MPC&A systems are described below:

Physical protection systems are designed to detect and delay any unauthorized penetration of barriers and portals, and to respond with immediate investigation and use of force, if necessary. Physical protection measures are generally the most visible and pervasive components of a nuclear safeguards system. Guards, fences, multiple barriers to entry, limited access points, alarms, and motion detectors are all examples of elements of a physical protection system.

Figure 5. *New fence installed by MPC&A program in Ukraine*



[5] For example see INFCIRC/225/Rev. 3, "The Physical Protection of Nuclear Material," International Atomic Energy Agency, (Vienna, 1993), and "The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons", (INFCIRC/153), the International Atomic Energy Agency, (Vienna, 1972), pp. 3, 9.

Figure 6. *Tamper-indicating device on nuclear material container*

Figure 7. *Portal monitors installed by MPC&A program in Russia*

Material control systems are designed to limit access and use of nuclear material and to detect promptly the theft or diversion of the material should it occur. These systems may include portal monitors and other devices to control egress from storage sites. Material control is also achieved through the use of secure containers for nuclear material, seals, and identification codes that make it possible to verify easily the location and condition of nuclear material, as well as material use and storage rules and procedures.

Material accounting systems are designed to confirm the presence of nuclear material in inventory, to measure the loss of any material not accounted for, and to provide information for follow-up investigation. Material accounting systems include both traditional inventory systems and an array of equipment to measure the types and quantities of nuclear material in a given area.

Figure 8. *Bar-code reader installed at nuclear facility in Kazakhstan*

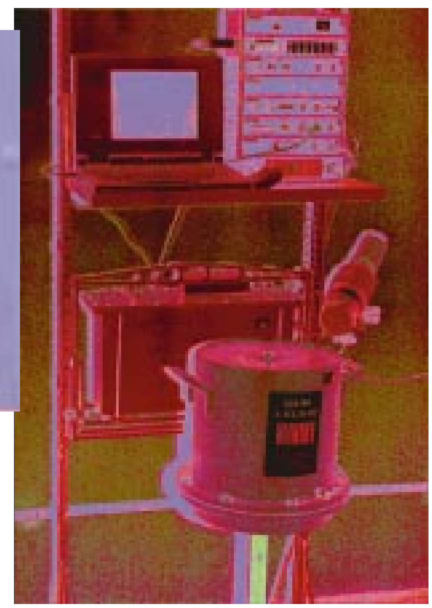
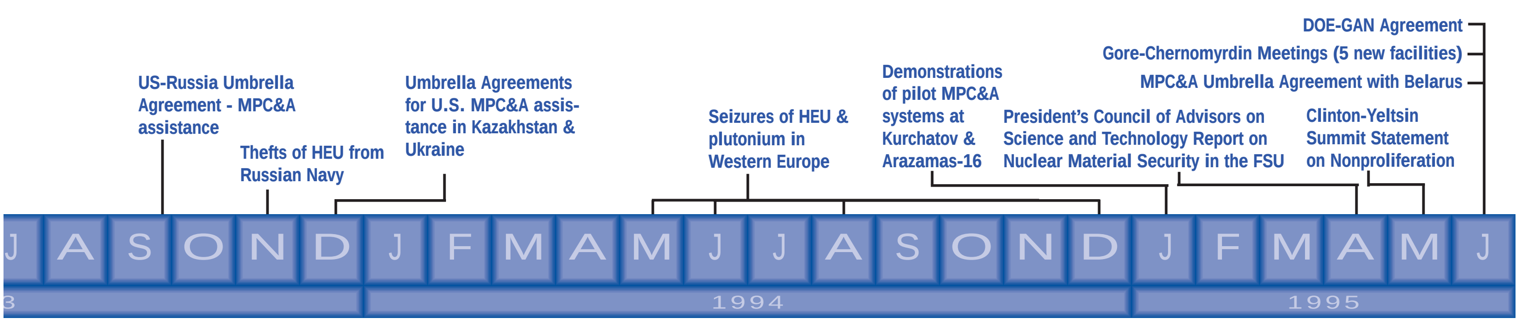


Figure 9. *Gamma detector to measure uranium enrichment*

Typically reinforcing the three major components of a MPC&A system is a program to ensure the reliability of the personnel who will be operating the system, including security screening, indoctrination, training, and personnel record keeping functions.



C. U.S. Initiatives to Improve Nuclear Material Security

The Cooperative Threat Reduction Program

Cooperative efforts to upgrade MPC&A in Russia, Ukraine, Belarus, and Kazakhstan were proposed in March, 1992, and were supported by funds made available by the "Soviet Nuclear Threat Reduction Act of 1991"--also known as the "Nunn-Lugar" act after its leading authors. This legislation and similar legislation during the period 1992-1995 provided funding for the Cooperative Threat Reduction (CTR) Program directed by the U.S. Department of Defense. Negotiations over these proposals progressed slowly, especially with Russia, and joint MPC&A projects at facilities containing weapons-usable nuclear material in these states did not begin until mid-1994. A significant milestone in initiating joint work on MPC&A was achieved by the CTR program in January, 1995, when an agreement between the U.S. Department of Defense and Russia's Ministry of Atomic Energy (Minatom) was amended to add $20 million for joint MPC&A upgrades. Similar agreements increasing available funds were signed with Ukraine, Belarus and Kazakhstan.

Figure 10. *Senators Nunn and Lugar, Washington, DC*

"The most serious national security threat facing the U.S., its allies, and its interests is theft of nuclear weapons or weapons-usable materials from the former Soviet Union." (Senator Nunn, July 1996)

"If the United States is to have any choice of stopping the detonation of a weapon of mass destruction on our own soil, prevention must start at the source – the weapons and material depots and research institutes in the former Soviet Union and elsewhere." (Senator Lugar, October 1997)

Figure 11. *U.S. and Russian scientists at the Institute of Physics and Power Engineering (IPPE), Russia*

"DOE's MPC&A assistance has allowed our plant to take its efforts to improve nuclear material security to a qualitatively new level." (Pavel Mizin, Scientific Production Association Luch, July 1997)

The Laboratory-to-Laboratory Initiative

In April, 1994, the DOE initiated a second approach to joint MPC&A cooperation with Russia that encouraged U.S. national laboratories to cooperate directly with the Russian Federation's nuclear institutes to improve MPC&A. This effort was designed to complement the original Government-to-Government approach and achieve more rapid joint progress on MPC&A. This initiative was known as the Laboratory-to-Laboratory program because it was based on the successful foundation of scientific collaborations established in 1992 between U.S. national laboratories and the Russian nuclear weapons institutes (see Figure 11).

Presidential Decision Directive 41: issued transfer of MPC&A program to DOE

Clinton-Yeltsin Summit Statement on Nuclear Security

Gore-Chernomyrdin Meeting (6 new facilities)

Commissioning ceremony for new MPC&A system at Salaspils, Latvia

Commissioning ceremony for new MPC&A system at Tbilisi, Georgia

DOE-Minatom Joint Statement on Nuclear Materials Transportation Security

Gore-Chernomyrdin Meeting (4 new facilities)

DOE-Russian MOD Joint Statement on MPC&A for naval fuels

Commissioning ceremony for new MPC&A systems at Sosny, Belarus; Tashkent, Uzbekistan; and Ignalina, Lithuania

Gore-Chernomyrdin Meeting (Annex signed to include nuclear weapons assembly/disassembly plants in MPC&A program)

Peña-Mich sign MPC& agreement Lytkarino

J A S O N D J F M A M J J A S O N D J F M A M

1995 1996

Presidential Involvement

In 1995, the MPC&A program was greatly strengthened by the direct involvement of the White House. In particular, the May 10, 1995, Clinton-Yeltsin Joint Statement on Nonproliferation reaffirmed the two states' commitment "to strengthen national and international regimes of control, accounting, and physical protection of nuclear materials and to prevent illegal traffic in nuclear materials." (see Figure 12)

More progress was achieved when Vice President Gore and Russian Prime Minister Chernomyrdin agreed to make MPC&A improvement a top priority for both governments (see Figure 13). This agreement led to the June 1995 signing of a Joint Statement by former U.S. Secretary of Energy Hazel O'Leary and Russian Atomic Energy Minister Viktor Mikhailov, initiating MPC&A upgrades at five key sites in Russia. At the same time, the DOE and Gosatomnadzor (GAN), the Russian nuclear regulatory agency, signed an agreement for cooperation that focused on creating a standardized national system for safeguarding nuclear material and providing MPC&A upgrades at six additional sites in Russia.

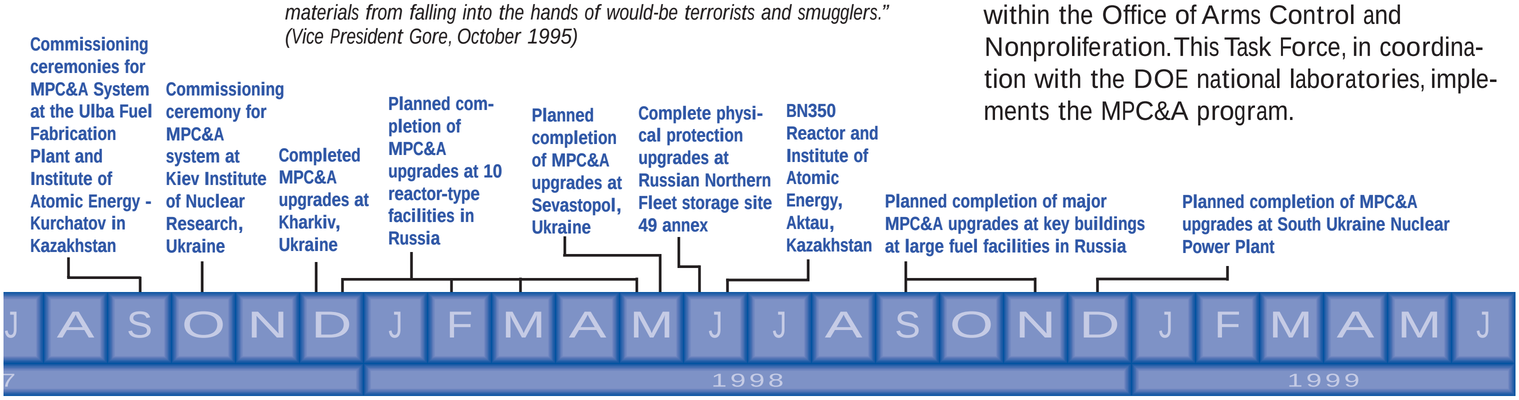
Figure 12. *Clinton-Yeltsin Summit*
"Overall, the creation of systems of accounting, control, and physical protection of nuclear materials has become a priority task of our state." (President Yeltsin, April 1996)

Figure 13. *Prime Minister Chernomyrdin and Vice President Gore*
"Americans and Russians are now working side by side to prevent nuclear materials from falling into the hands of would-be terrorists and smugglers." (Vice President Gore, October 1995)

Additional support from the White House came in September, 1995, when President Clinton issued a Presidential Decision Directive on "U.S. Policy on Improving Nuclear Material Security in Russia and the Other Newly Independent States" (PDD/NSC-41). This directive established cooperation with Russia, the NIS, and the Baltic states to improve the security of nuclear materials as one of the nation's top national security objectives. Under this directive the DOE was assigned formal responsibility within the U.S. government for directing the MPC&A program.

Creation of the Task Force

To meet the responsibility assigned by PDD-41 in September, 1995, the DOE created the Russia/NIS Nuclear Material Security Task Force within the Office of Arms Control and Nonproliferation. This Task Force, in coordination with the DOE national laboratories, implements the MPC&A program.



D. Program Guidelines

Mission

The mission of the MPC&A program is to reduce the threat of nuclear proliferation and nuclear terrorism by rapidly improving the security of all weapons-usable nuclear material in forms other than nuclear weapons in Russia, the NIS, and the Baltics.

Goals and Strategies

1. Reach Agreement for MPC&A Cooperation with all Sites in Russia, the NIS, and the Baltics Containing Weapons-Usable Nuclear Material in Forms Other than Nuclear Weapons:

A. Overcome mutual Cold War suspicions, lack of technical working relationships, security issues at closed nuclear cities, and language and cultural differences.

B. Establish contracts or other agreements to upgrade MPC&A at all facilities within these sites which store, process or transport Pu or HEU. (See Figure 14)

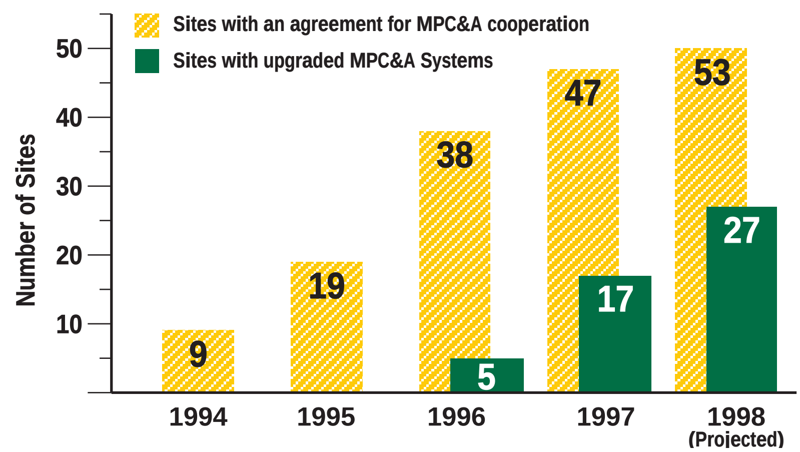


Figure 14. *Sites of MPC&A Cooperation with Agreements and Upgraded Systems.*

2. Implement Systematic and Rapid MPC&A Upgrades at all Sites:

A. Concentrate MPC&A efforts on the most attractive materials for nuclear weapons, namely, HEU (20% and greater) and Pu (excluding Pu in irradiated fuel).

B. Install comprehensive, technology-based MPC&A systems that are consistent with international standards, such as IAEA INFCIRC/225 and the IAEA Guidelines for State Systems for Accounting and Control (SSAC), which are appropriate for the unique conditions at each site and effective for securing nuclear material against insider and outsider threats.

C. Use proven MPC&A methods and technologies.

D. Use both indigenous (Russian, the NIS, and the Baltics) and foreign technologies, depending on the technical merits. Indigenous technologies, when available, may have advantages in terms of cost, maintainability, acceptance, and other factors. Foreign technologies, on the other hand, may have advantages in terms of uniqueness, availability, reliability, track record, and other factors. Decisions on using these technologies is to be made jointly, taking all relevant factors into account.

E. Transfer full responsibility for the long-term operation of upgraded MPC&A systems to our partners after the completion of cooperative upgrades and provision of associated manufacturer guarantees.

F. Assist guard forces with radiocommunications, investigative techniques, and other mechanisms/capabilities to improve guard force operations, without providing training in the use of force or purchasing weapons.

3. **Ensure Long-Term Effectiveness of Improved MPC&A Systems:**

   A. Establish MPC&A training programs. (See Figure 15)

   B. Strengthen national nuclear regulatory systems and national standards for MPC&A.

   C. Foster indigenous production and maintenance of MPC&A equipment.

   D. Conduct annual reviews of vulnerabilities and hardware to determine if additional MPC&A upgrades are required to meet changing conditions.

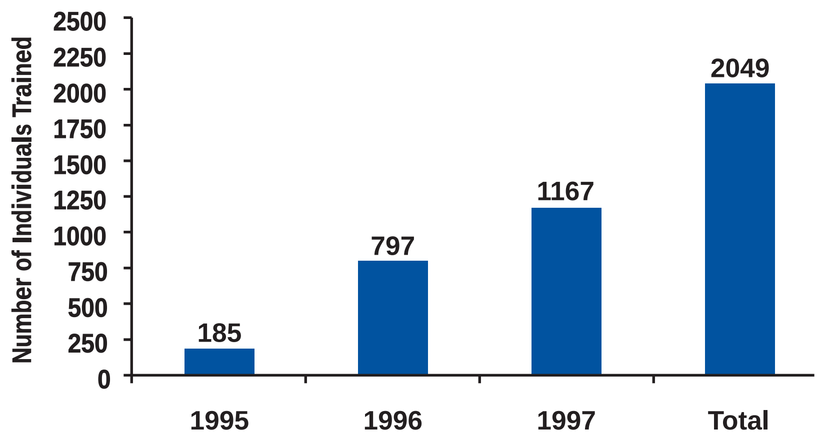


Figure 15. *MPC&A Training Progress by Number of Participants.*

4. **Achieve Technical Integrity and Openness**

   A. Carefully protect sensitive information and technologies in all facets of the program.

   B. Sustain MPC&A program as a multilaboratory program operating under DOE guidance and oversight. Ensure U.S. experts (DOE, laboratory, and contractor personnel) work together as a unified team committed to common objective.

   C. Ensure that the basic operating principle of the MPC&A program aligns with capabilities and responsibilities. Assign work according to demonstrated capability and capacity in accomplishing program objectives.

   D. Follow a disciplined approach in planning and executing projects. Assess proposed work in terms of is it needed; is it timely; is it cost-effective; have all unnecessary activities and costs been eliminated?

Frequently Used MPC&A Upgrades

1. Physical protection systems: locks, fences, barriers, gates, badging systems, and interior and exterior sensors, including video cameras and motion detectors.

2. Alarm systems and computers to process data from sensors, such as closed-circuit television and communication systems to improve response to alarms.

3. Nuclear material detectors installed at pedestrian and vehicle portals which detect attempts to remove nuclear material, including hand-held detectors for random guard-force checking.

4. Tamper-indicating devices to prevent unauthorized removal, computerized MPC&A systems, including barcode systems, to track nuclear material inventory.

5. Perimeter clearing and structural improvements to improve physical protection.

6. Computerized material accounting systems to maintain physical inventory and non-destructive assay measurements.

Sites of MPC&A Cooperation

Sites of MPC&A Cooperation

DEFENSE RELATED SITES

Uranium and Plutonium Cities

1. Chelyabinsk-65/*Ozersk*, Mayak Production Association
2. Tomsk-7/*Seversk*, Siberian Chemical Combine
3. Krasnoyarsk-26/ *Zheleznogorsk*, Mining and Chemical Combine
4. Krasnoyarsk-45/ *Zelenogorsk*, Uranium Isotope Separation Plant
5. Sverdlovsk-44/*Novouralsk*, Urals Electrochemical Integrated Plant

Nuclear Weapons Complex

6. Arzamas-16/*Sarov*, All-Russian Scientific Research Institute of Experimental Physics (VNIIEF)
7. Chelyabinsk-70/*Snezhinsk*, All-Russian Scientific Research Institute of Technical Physics (VNIITF)
8. Avangard Plant
9. Sverdlovsk-45/*Lesnoy*
10. Penza-19/*Zarechnyy*
11. Zlatoust-36/*Trekhgornyy*

Maritime Fuel

12. Navy Site 49
13. Navy 2nd Northern Fleet Storage Site
14. Navy Site 34
15. PM-63 Refueling Ship
16. PM-12 Refueling Ship
17. PM-74 Refueling Ship
18. Sevmash Shipyard
19. Icebreaker Fleet
20. Kurchatov Institute
    Navy Regulatory Project
    Navy Training Project

Transportation

R Railcars
T Trucks

*Italics indicate new Russian place names.

CIVILIAN AND REGULATORY RELATED SITES

Large Fuel Facilities

21. Elektrostal Production Association Machine Building Plant (POMZ)
22. Novosibirsk Chemical Concentrates Plant
23. Podolsk, Scientific Production Association Luch
24. Dmitrovgrad, Scientific Research Institute of Atomic Reactors (NIIAR)
25. Obninsk, Institute of Physics & Power Engineering (IPPE)
26. Bochvar All-Russian Scientific Research Institute of Inorganic Materials (VNIINM)

Reactor-Type Facilities

27. Dubna, Joint Institute of Nuclear Research, (JINR)
28. Scientific Research and Design Institute of Power Technology (RDIPE)
29. Moscow Institute of Theoretical and Experimental Physics (ITEP)
30. Moscow State Engineering Physics Institute (MEPhI)
31. Karpov Institute of Physical Chemistry
32. Beloyarsk Nuclear Power Plant (BNPP)
33. Sverdlovsk Branch of Scientific Research and Design Institute of Power Technology (SF-NIKIET)
34. Khlopin Radium Institute
35. Tomsk Polytechnical University (TPU)
36. Petersburg Nuclear Physics Institute (PNPI)
37. Krylov Shipbuilding Institute
38. Lytkarino Research Institute of Scientific Instruments
39. Norilsk
40. Baltiysky Zavod

Regulatory Projects - Russia

GAN Project 1, Regulatory Development
GAN Project 2, Federal MC&A Information System
GAN Project 3, MC&A Equipment for Inspectors
GAN Project 4, MPC&A Oversight & Information System
All-Russian Scientific Research Institute of Automatics (VNIIA)
ELERON (Special Scientific and Production State Establishment)
Bochvar Measurement and Reference Materials
DOE Minatom Regulatory

Training/Education - Russia

GAN Project 5, Inspector Training
Russian Methodological Training Center, Obninsk
MEPhI Graduate Program
TPU Graduate Program

NIS AND BALTIC SECTOR

41. Aktau, BN-350 Breeder Reactor
42. Almaty, Research Reactor
43. Institute of Atomic Energy, Kurchatov
44. Ulba Fuel Fabrication Plant, Ust-Kamenogorsk
45. Kharkiv Institute for Physics and Technology (KPIT)
46. Kiev Institute of Nuclear Research (KINR)
47. Sevastopol Naval Institute
48. South Ukraine Nuclear Power Plant (SUNPP)
49. Sosny Institute of Nuclear Power Engineering, Minsk
50. Tbilisi, Institute of Physics
51. Tashkent, Institute of Nuclear Physics
52. Ignalina Nuclear Power Plant (INPP)
53. Salaspils Institute of Nuclear Physics

A. Program Organization

Department of Energy Headquarters

When President Clinton issued his Presidential Decision Directive on "U.S. Policy on Improving Nuclear Material Security in Russia and Other Newly Independent States" (PDD/NSC-41) in September 1995, he provided detailed guidance for the efforts of U.S. Government in this area. President Clinton also appointed the DOE as Executive Agent for MPC&A programs.

As a result of PDD-41, in September 1995, the DOE created the Russian/NIS Nuclear Material Security Task Force as a limited-term organization to lead the U.S. effort to improve the security of weapons-usable nuclear material in the Former Soviet Union (FSU). The Russian/NIS Nuclear Material Security Task Force staff, located within the Office of Arms Control and Nonproliferation at DOE headquarters in Washington, D.C., is responsible for the overall planning and implementation of the MPC&A program (see Figure 16).

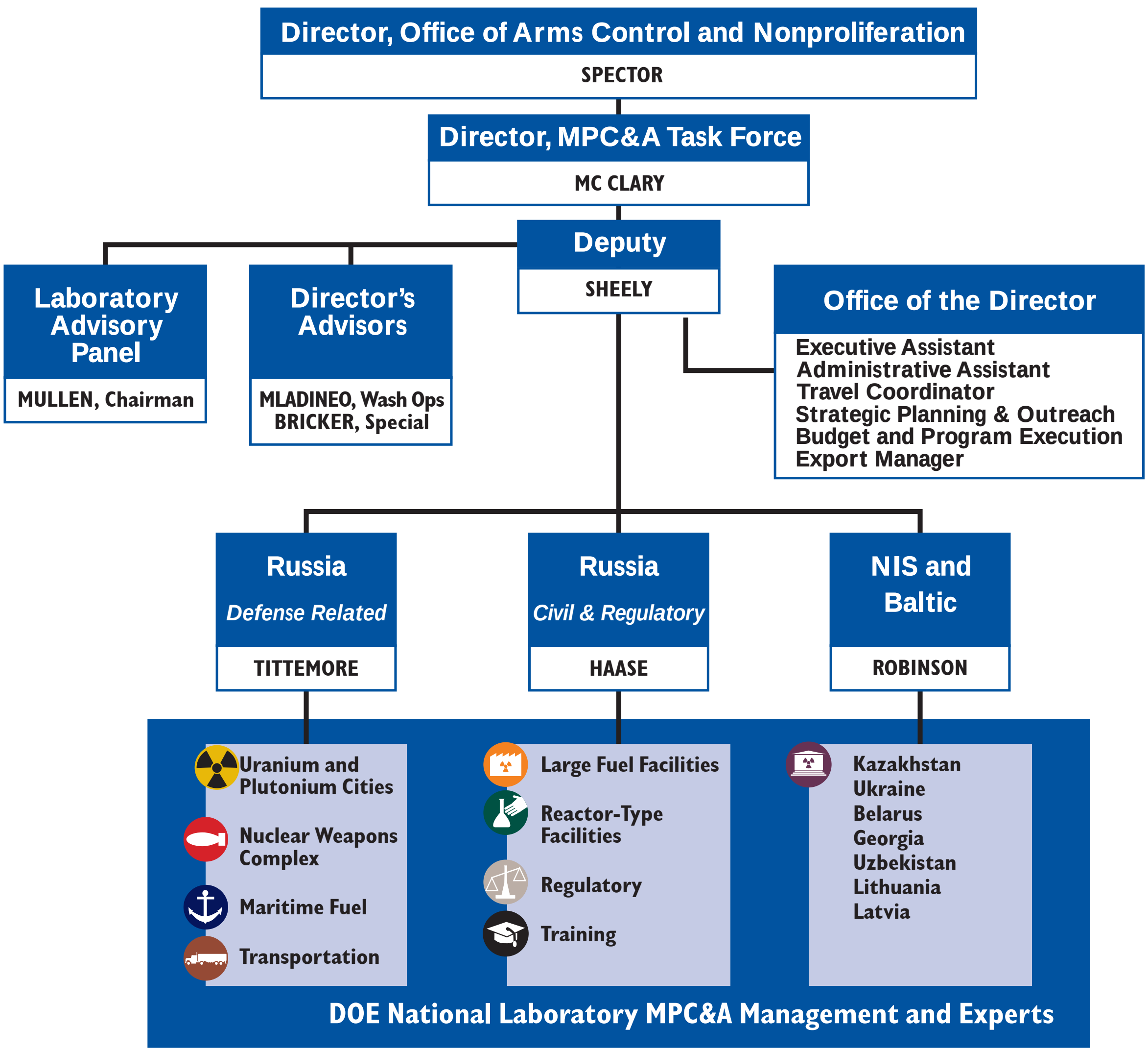


Figure 16. *MPC&A Task Force organization*

The Task Force[6]

- – Establishes the MPC&A Program's goals and priorities;
- – Sets Program's strategies and guiding principles;
- – Approves individual project workplans, which set the detailed scope of work for each of the sites and projects;
- – Determines project budgets and monitors project execution;
- – Coordinates with U.S. and FSU government agencies;
- – Ensures Program meets all legal requirements by approving and maintaining program management, export controls, and program assurance documentation; and
- – Provides guidance to DOE national laboratory MPC&A experts.

Program Structure

The MPC&A Program has been divided into nine sectors:

- **– Russian Defense Related Sites:** Contains the largest fraction of weapons-usable nuclear material in Russia, including:
  - Uranium and Plutonium Cities, which produce and store large quantities of HEU and Pu;
  - Nuclear Weapons Complex, including research and nuclear weapons dismantlement sites;
  - Maritime Fuel, including HEU used to power navy submarines and commercial icebreakers; and
  - Transportation, which involves the shipment of HEU and Pu between Russia sites.
- **– Russian Civil and Regulatory Projects:** Includes a number of commercial reactor and fuel development and test facilities, research institutes, and infrastructure projects, including:
  - Large Fuel Facilities, which design and produce advanced reactors and HEU and Pu fuels;
  - Reactor-Type Facilities, including 14 research and test reactor and support institutes;
  - Regulatory, to establish solid national level nuclear regulatory foundation; and
  - Training, to establish accredited university programs and training centers for MPC&A experts.
- **– The NIS and Baltics:**
  - Nuclear materials located at civilian facilities in Kazakhstan, Ukraine, Belarus, Georgia, Uzbekistan, Lithuania, and Latvia.

DOE National Laboratories

Technical experts from the DOE national laboratories work directly with their counterparts in Russia, the NIS, and the Baltics and have primary responsibility for designing and installing upgraded MPC&A systems, as well as for leading MPC&A training activities. In addition, DOE national laboratory teams play a major role in providing assistance for the development of national nuclear regulatory systems. These programs are implemented by Russian, NIS, and Baltics institutes and enterprises, using both American and local equipment and methods. The DOE national laboratories provide funding for the Russian, NIS, and Baltic institutes through direct contracts. The DOE national laboratories and their counterparts in the FSU also share technical information and experience from their respective applications of MPC&A methods and technologies.

In order for the DOE national laboratories to contribute to the MPC&A Program fully and effectively, a Laboratory Advisory Panel has been established to provide expert technical advice to the Director, Deputy Director, and Headquarters Program Managers of the Russia/NIS Nuclear Materials Security Task Force.[7] This panel provides a forum for the technical experts from the DOE national laboratories to meet and develop recommendations on key aspects of the MPC&A program including strategic and program planning; leadership and composition of project teams; and the maintenance of effective working relationships with their counterparts in the cooperating states. The Panel provides a valuable exchange of information and guidance between national laboratories and DOE headquarters.

[6] As documented in *Russia/NIS Nuclear Materials Security Task Force: Duties and Responsibilities*, June 1997.

[7] *Laboratory Advisory Panel Charter, annex to the Russia/NIS Nuclear Materials Security Task Force: Duties and Responsibilities*, June 1997.

B. Program Management

For each site containing weapons-usable nuclear material MPC&A Task Force program managers create a project workplan.[8] This workplan contains a description of the site, its MPC&A requirements and needs, and the schedule for implementing and completing MPC&A upgrades. This project workplan evolves as work is completed, with the current status reflected in periodic progress reports. Project budget formulation and the establishment of mechanisms to provide assurance that U.S. government funds committed to the MPC&A program are being used effectively and for their intended purpose are also important project management responsibilities.[9] Internal procedures ensure that the project workplan complies with all export control requirements, such as licensing and reporting.[10] A DOE Headquarters Export manager is assigned to carry out these responsibilities on a program-wide basis.

Technical guidelines for MPC&A upgrades ensure that all projects are cost-effective, meet up-to-date internal requirements, and are comparable with the latest international standards for MPC&A. The focus of the program is on implementation, not research and development, although in some cases MPC&A methods and technologies may require modifications or adaptations to fit conditions and requirements in Russia, the NIS, and the Baltics. Locally produced equipment is used whenever possible and appropriate, and the development of indigenous capabilities to support the operation and maintenance of such equipment is also supported. Figure 17 describes the basic technical approach to planning site-level MPC&A upgrades.

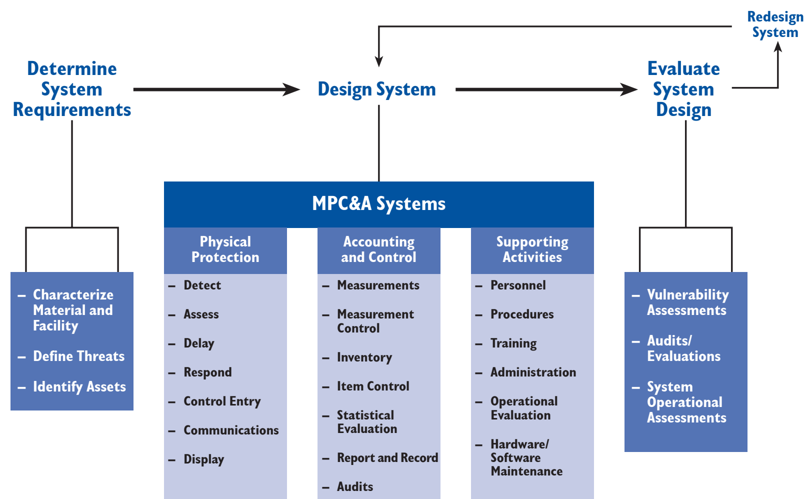


Figure 17. *MPC&A design and evaluation process*

Two other critical concepts that guide the design and operation of modern MPC&A systems are the principles of "graded safeguards" and "defense in depth" against a spectrum of threats. Under a graded safeguards approach, the effort and resources devoted to improving MPC&A are commensurate with the risks presented to the nuclear material and with the level of proliferation risk that would result if the material were stolen or diverted. This approach assumes that nuclear materials that are most readily usable in nuclear weapons present a high proliferation risk and are a more "attractive" target for theft or diversion than materials that are less weapons-usable. The concept of defense in depth requires redundant and diverse layers of defense to increase the difficulty of penetration and to guarantee that the failure of any single defensive layer will not result in unauthorized access to or loss of nuclear material. Figure 18 demonstrates a sample site with "graded safeguards" and "defense in depth" concepts in place.

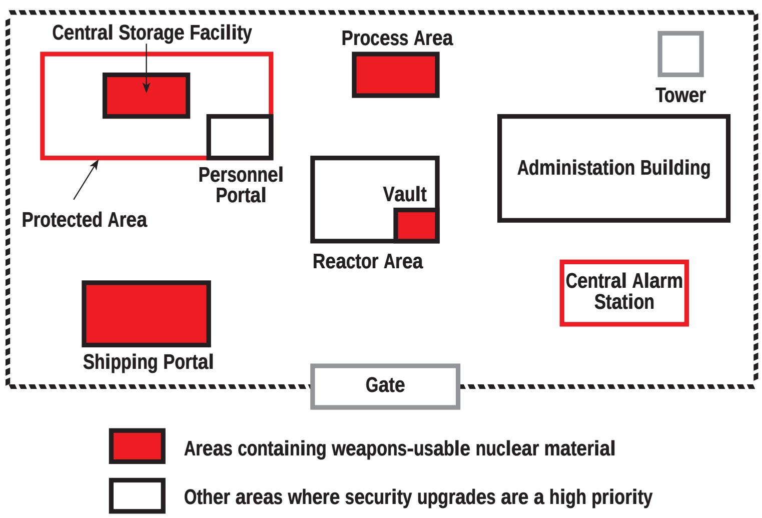


Figure 18. *Schematic site diagram of modern MPC&A system in place*

[8] MPC&A Program Project Management Document, U.S. Department of Energy, June 1997.

[9] DOE MPC&A Program Assurance Procedures, U.S. Department of Energy, September 1997.

[10] International Cooperative License, S000005, U.S. Department of Energy, October 1997.

C. Program Budget

Total MPC&A program expenditures through fiscal year 2002 are estimated to be $800 million, with highest annual funding levels planned for fiscal year 1999. Funding for the MPC&A program for the period 1993-1998 is shown in Figure 19.

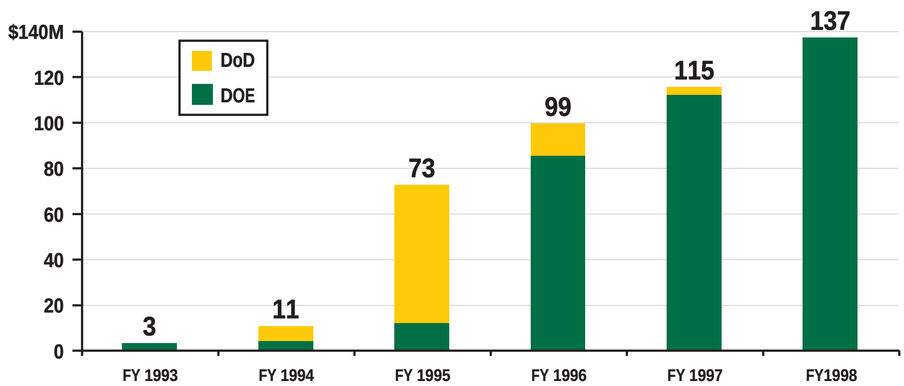


Figure 19. *Funding for the MPC&A program during 1993-1998 time period*

D. Project Phases

MPC&A System Start Up

The critical programmatic milestone for MPC&A cooperation at each site is the commissioning of an operational, upgraded MPC&A system covering all weapons-usable nuclear materials at the site. Each MPC&A system is designed to collect accurate nuclear materials inventory information; protect and control nuclear materials in order to deter and prevent loss or misuse; provide timely and localized detection of unauthorized removals of nuclear materials within specific limits; and give assurance that all nuclear materials are accounted for and that theft and diversion have not occurred. This is the most visible benchmark upgrading security. However, even after this key objective is attained, continued support is needed to ensure all systems are functioning and all security staff are knowledgeable and following well-documented procedures.

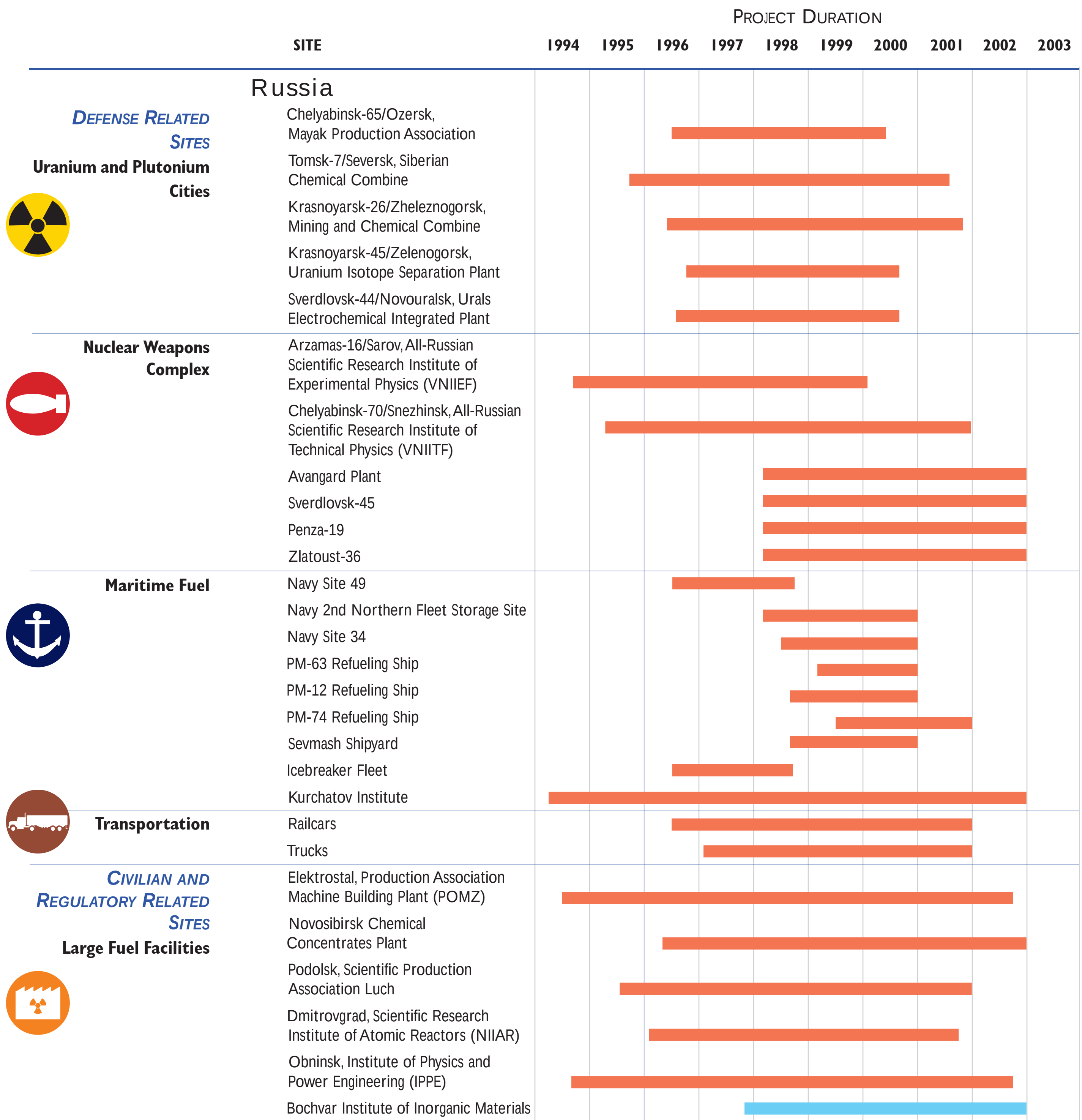
MPC&A System Operational Assessments

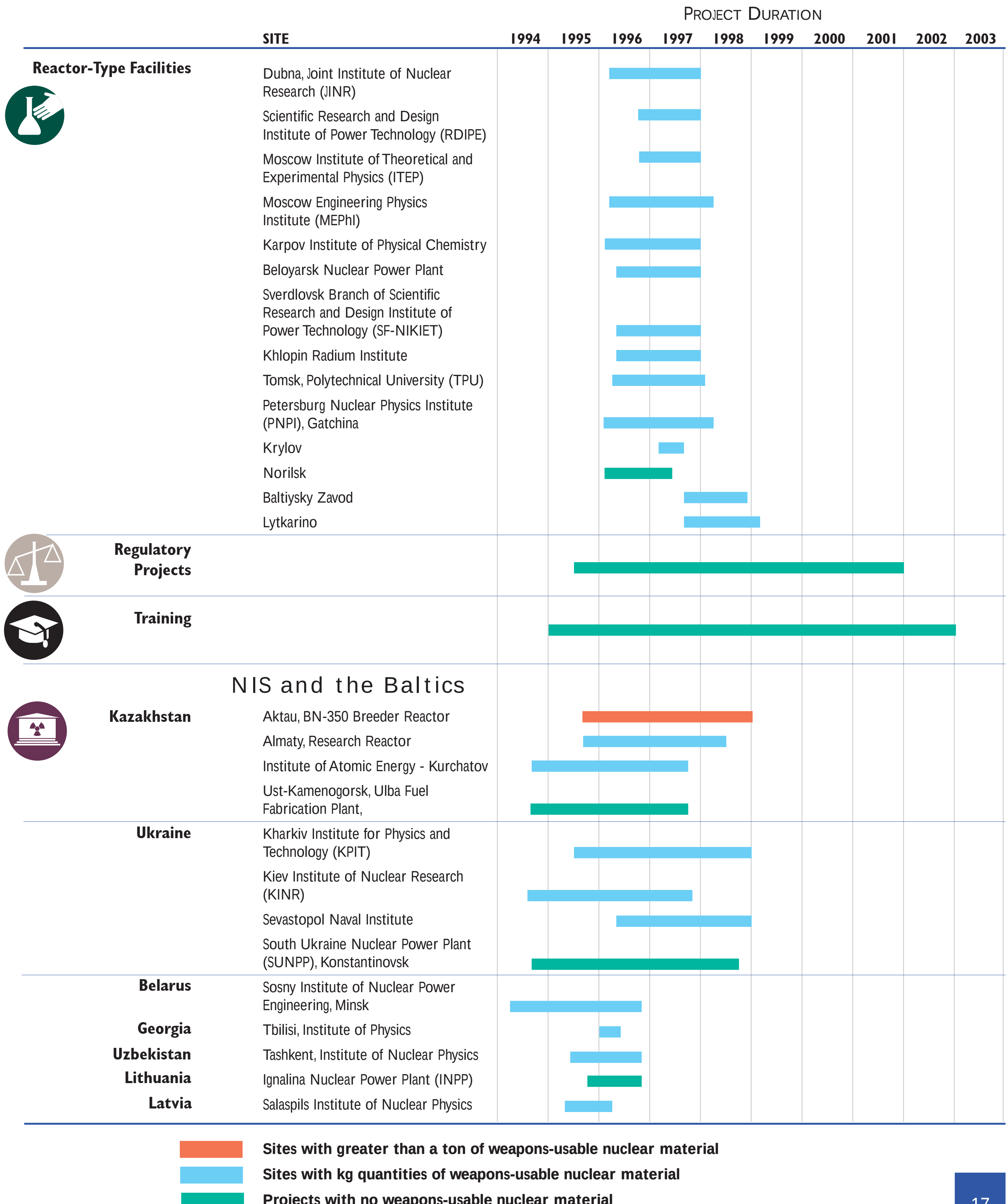
Once an upgraded MPC&A system is commissioned, cooperative activities change focus from technical upgrades to operational assessments. A major objective of the MPC&A program is to help the cooperating states establish indigenous capabilities for maintaining effective MPC&A systems. To achieve this objective, MPC&A upgrades using indigenous equipment are installed whenever appropriate, and MPC&A training and educational programs are made an integral part of project planning. Other activities that help ensure the long-term sustainability of MPC&A upgrades include conducting periodic reviews to ensure all elements of the system are functional, that operators are following well documented procedures, and that 24-hour system operation is in place. Additionally, the Task Force supports independent evaluations of MPC&A projects by national and international regulatory agencies. This emphasis on improving indigenous MPC&A capabilities helps prepare each site for the eventual reduction in Task Force assistance that occurs when upgraded MPC&A systems at that site become fully operational.

Long-Term Security

The ultimate objective of the MPC&A program is for the cooperating states to support the continued operation of upgraded MPC&A systems at the national and site level, thus ensuring the security of all weapons-usable nuclear material within their borders. This outcome begins a new stage of nuclear security cooperation, during which U.S. assistance is significantly reduced. Continued efforts such as training, maintenance, and material consolidation will help improve nuclear material security in the future.

A. Schedule


PROJECT DURATION
SITE
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Russia
DEFENSE RELATED SITES
Uranium and Plutonium Cities
Chelyabinsk-65/Ozersk, Mayak Production Association
Tomsk-7/Seversk, Siberian Chemical Combine
Krasnoyarsk-26/Zheleznogorsk, Mining and Chemical Combine
Krasnoyarsk-45/Zelenogorsk, Uranium Isotope Separation Plant
Sverdlovsk-44/Novouralsk, Urals Electrochemical Integrated Plant
Nuclear Weapons Complex
Arzamas-16/Sarov, All-Russian Scientific Research Institute of Experimental Physics (VNIIEF)
Chelyabinsk-70/Snezhinsk, All-Russian Scientific Research Institute of Technical Physics (VNIITF)
Avangard Plant
Sverdlovsk-45
Penza-19
Zlatoust-36
Maritime Fuel
Navy Site 49
Navy 2nd Northern Fleet Storage Site
Navy Site 34
PM-63 Refueling Ship
PM-12 Refueling Ship
PM-74 Refueling Ship
Sevmash Shipyard
Icebreaker Fleet
Kurchatov Institute
Transportation
Railcars
Trucks
CIVILIAN AND REGULATORY RELATED SITES
Large Fuel Facilities
Elektrostal, Production Association Machine Building Plant (POMZ)
Novosibirsk Chemical Concentrates Plant
Podolsk, Scientific Production Association Luch
Dmitrovgrad, Scientific Research Institute of Atomic Reactors (NIIAR)
Obninsk, Institute of Physics and Power Engineering (IPPE)
Bochvar Institute of Inorganic Materials



PROJECT DURATION
SITE
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003
Reactor-Type Facilities
Dubna, Joint Institute of Nuclear Research (JINR)
Scientific Research and Design Institute of Power Technology (RDIPE)
Moscow Institute of Theoretical and Experimental Physics (ITEP)
Moscow Engineering Physics Institute (MEPhI)
Karpov Institute of Physical Chemistry
Beloyarsk Nuclear Power Plant
Sverdlovsk Branch of Scientific Research and Design Institute of Power Technology (SF-NIKIET)
Khlopin Radium Institute
Tomsk, Polytechnical University (TPU)
Petersburg Nuclear Physics Institute (PNPI), Gatchina
Krylov
Norilsk
Baltiysky Zavod
Lytkarino
Regulatory Projects
Training
NIS and the Baltics
Kazakhstan
Aktau, BN-350 Breeder Reactor
Almaty, Research Reactor
Institute of Atomic Energy - Kurchatov
Ust-Kamenogorsk, Ulba Fuel Fabrication Plant,
Ukraine
Kharkiv Institute for Physics and Technology (KPIT)
Kiev Institute of Nuclear Research (KINR)
Sevastopol Naval Institute
South Ukraine Nuclear Power Plant (SUNPP), Konstantinovsk
Belarus
Sosny Institute of Nuclear Power Engineering, Minsk
Georgia
Tbilisi, Institute of Physics
Uzbekistan
Tashkent, Institute of Nuclear Physics
Lithuania
Ignalina Nuclear Power Plant (INPP)
Latvia
Salaspils Institute of Nuclear Physics
Sites with greater than a ton of weapons-usable nuclear material
Sites with kg quantities of weapons-usable nuclear material
Projects with no weapons-usable nuclear material

B. MPC&A Progress:

1997 Accomplishments

Uranium and Plutonium Cities

- Completed interior sensor upgrades at plutonium oxide storage buildings at Mayak.
- Finalized MPC&A System design for the RT-1 Plutonium storage facility at the Mayak Production Association. This facility contains metric tons of plutonium.
- Installed 4 SNM portal monitors at pedestrian entry/exit points at Mayak.
- Commissioned site-wide portal monitor and metal detector installation at Tomsk-7.
- Planning is under way for additional MPC&A upgrades at the Radiochemical Uranium Enrichment, Chemical Metallurgical, and Conversion Plants at Tomsk-7.
- Completed nuclear material detection installation at primary HEU storage facility at Krasnoyarsk-45.

Pedestrian Portal Monitor at Tomsk-7 Enrichment Plant

Nuclear Weapons Complex

- Installed new MPC&A systems at reactor and production facilities at Arzamas-16 which increases the security of several metric tons of weapons-usable nuclear material.
- Initiated MPC&A cooperation for the industrial facility and nuclear materials storage facilities at Arzamas-16.
- Installed nuclear material detectors at all pedestrian entry/exit points at Chelyabinsk-70.

Vehicle Portal Monitor at Chelyabinsk-70

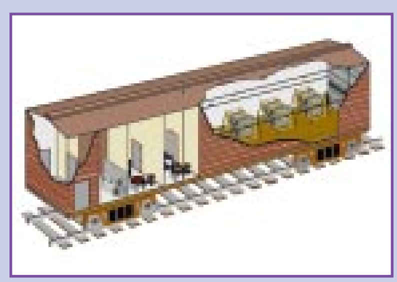
Maritime Fuel

- Completed construction of physical protection annex at Northern Fleet nuclear fresh fuel storage facility (Site 49).
- Completed MPC&A designs for fresh fuel storage on icebreaker refueling ship “Imandra”.
- Completed site visit and vulnerability analysis for Russian Navy Refueling Ship PM-63.

Annex to Northern Fleet Fresh Fuel Storage Site

Transportation

- Completed initial design for rapid upgrades for MINATOM railcar fleet.
- Completed test operation of 2 prototype railcars on a five-day trip over Russian railroads.
- Delivered prototype intra-site secure truck for Tomsk-7.



Security Upgrades for Minatom Rail Cars

1998-99 Goals

- Commission new MPC&A systems at Plant 1, Isotope Production Plant, Isotope Production Reactor Plant, RT-1 Plutonium Storage Facility, RT-1 Reprocessing Plant, and temporary storage vault at Mayak.
- Commission site-wide vehicle monitor installation and reactor plant MPC&A systems at Tomsk-7.
- Complete MPC&A upgrades at Krasnoyarsk-26 plutonium storage facilities and commission site access systems.
- Commission MPC&A system at primary HEU storage facility, intermediate storage flourination facility, and perimeter access control system at Krasnoyarsk-45.
- Complete MPC&A systems at the Uranium Recovery/HEU storage vaults and modules 3 and 4 of the Centrifuge building at Sverdlovsk-44.
- Commission central alarm station physical protection systems, security communications systems and south perimeter controls at Sverdlovsk-44.

Video Monitor Installation

- Complete MPC&A upgrades at Pulsed Reactor Facility and Buildings 726, 326, 717, and 719 at Chelyabinsk-70.
- Initiate MPC&A upgrades at the Industrial Facility and Experimental Testing Facility at Arzamas-16.
- Install portal monitors at all perimeter access points at the serial production facilities.

Personnel Access Control (mantrap) at Arzamas-16

- Commission MPC&A system at Northern Fleet Storage Facility (Site 49).
- Begin MPC&A upgrades at Sevmash Shipyard.
- Commission MPC&A system for Icebreaker Refueling Ship “Imandra”.
- Complete MPC&A upgrades at Navy-related building at the Kurchatov Institute.
- Develop Navy MPC&A training and regulatory programs.
- Commission MPC&A systems for Refueling Ships PM-63 and PM-12.
- Expand MPC&A cooperation to include upgrades for the Pacific Fleet.

Nuclear Icebreaker of the Murmansk Shipping Company

- Complete MPC&A rapid upgrades on 35 railcars.
- Complete MPC&A truck upgrades for Russian Navy Northern Fleet.

Interior Rail Car Security Upgrades

1997 Accomplishments

Large Fuel Facilities

- Commissioned new MPC&A system at Building 274 at Elektrostal.
- Commissioned model MC&A upgrades at the BFS Critical Assembly, Obninsk.

Physical Protection Upgrades at Elektrostal

Reactor-Type Facilities

Commissioned new MPC&A systems at:

- BNPP
- ITEP
- JINR
- SF-NIKIET
- RDIPE
- Khlopin
- Karpov

Physical Protection Upgrades at PNPI

Regulatory Projects

- Assisted GAN with draft MPC&A Regulatory legislation that is awaiting adoption:
  - Regulations for Federal MC&A systems
  - Basic rules for nuclear MC&A
  - Provisions for MC&A inspections and physical protection oversight
- Provided MC&A equipment for GAN inspectors.
- Developed and operated prototype of National Nuclear Material Accounting System.

Bar Code & Container

Training

- Initiated new training programs at 10 sites.
- Provided U.S.-supported training for 2,000 personnel from Russian, NIS, and Baltic institutes.
- Established training programs at RMTC (Obninsk) and graduate program at MEPhI.
- Expanded GAN inspector training program.

MPC&A Training at MEPhI

NIS and Baltics

- Completed new MPC&A systems in Belarus and Uzbekistan.
- Commissioned new MPC&A systems at the Kiev Institute of Nuclear Research in Ukraine, the Institute of Atomic Energy, Kurchatov, and the Ulba Fuel Fabrication Plant in Kazakhstan.
- Completed MPC&A activities in Latvia, Lithuania, and Georgia in 1996 and transferred to DOE's International Safeguards Division in 1997.

Physical Protection Upgrades in Belarus

1998-99 Goals

- Commission MPC&A systems at Buildings 143A, 179 and the Central Alarm Station at Elektrostal.
- Commission MPC&A systems at the Chemical Analytical Laboratory, the Central Storage Facility, Central Alarm Station, and Uranium Processing buildings 34 and1 at Luch.
- Commission site-wide MPC&A upgrades at Novosibirsk.
- Commission MPC&A upgrades to the Central Storage Facility and Nuclear Island at Obninsk.
- Commission MPC&A systems for the Central Storage Facility Building 132, Building 160, and the Central Alarm Station at Dmitrovgrad.

HEU Fuel Containers at Elektrostal

- Commission new MPC&A systems at:
  - MEPhI
  - TPU
  - Krylov
  - Lytkarino
  - PNPI

Physical Protection Upgrades at JINR, Dubna, Russia

- Strengthen National Nuclear Material Accounting System.
- Improve independent licensing and inspection capability.
- Establish Minatom Regulatory Development Project.
- Complete regulations for federal MC&A systems, rules, and standards for nuclear energy.
- Begin operation of core computerized MC&A information system in Russia.
- Expand computerized inspection information system to all GAN regions containing direct-use nuclear materials.
- Routinize use of modern inspection equipment by GAN inspectors in the field.

Minatom Regulatory Training Project

- Build graduate level MPC&A training program at Tomsk Polytechnic University.
- Establish Urals-Siberian Training Center.
- Complete transition to Russian instructors for all MPC&A courses at the Russian Methodological Training Center at Obninsk and Urals-Siberian Training Center.
- Establish MPC&A training programs for GAN inspectors in all GAN regional areas.
- Implement job placement programs for MPC&A training program graduates.

Barcode Equipment Training for Russian Nuclear Facility Personnel

- Complete new MPC&A systems at:
  - Kharkiv, Sevastopol and South Ukraine nuclear power plant in Ukraine
  - Aktau and Almaty in Kazakhstan
- Transfer MPC&A activities in Belarus, Uzbekistan, Ukraine and Kazakhstan to DOE's International Safeguards Division.

New Central Alarm Display Console in Kiev, Ukraine

U.S. Department of Energy

Office of Arms Control and Nonproliferation