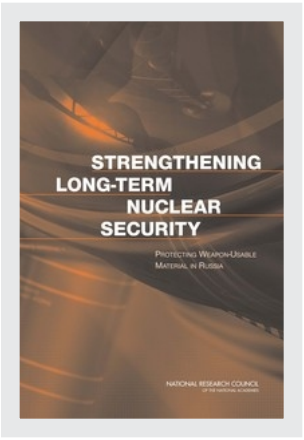

Strengthening Long-Term Nuclear Security: Protecting Weapon-Usable Material in Russia

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and Highly Enriched Uranium from Russian Facilities

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COMMITTEE ON INDIGENIZATION OF PROGRAMS TO PREVENT LEAKAGE OF PLUTONIUM AND HIGHLY ENRICHED URANIUM FROM RUSSIAN FACILITIES

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Preface

In 1997, the National Research Council (NRC) published a study funded by the U.S. Department of Defense (DOD) entitled *Proliferation Concerns: Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union.* In 1999, the NRC published a follow-on assessment funded by the U.S. Department of Energy (DOE) entitled *Protecting Nuclear Weapons Materials in Russia.* Both reports strongly supported the continuation of ongoing cooperative U.S.-Russian efforts to improve the protection, control, and accounting of highly enriched uranium (HEU) and plutonium in Russia that are suitable for use in nuclear weapons. The reports agreed that the DOE-funded materials protection, control, and accounting (MPC&A) program "represents an unusual and valuable opportunity to promote the interests of both countries."[1]

These cooperative efforts have been implemented under the leadership of DOE working jointly with the Russian Federal Agency for Atomic Energy (Rosatom), its predecessor organization, the Ministry of Atomic Energy (Minatom), and other Russian entities. A series of agreements and protocols between the U.S. and Russian governments has provided the framework for this joint effort. Appendix A includes the text of the most recent DOE-Minatom agreement, which was signed in 1999. The program to protect nuclear materials

[1]NRC. 1999. *Protecting Nuclear Weapons Materials in Russia,* National Academy Press, Washington, D.C., p. 38.

has been separate from the efforts of DOD, DOE, and Russian counterparts to address nuclear warheads. Therefore, this report, like the two previous reports, does not address DOE and DOD programs aimed at the security of nuclear warheads. Similarly excluded from consideration here are recent DOE activities to address the security of nuclear warheads at some Russian naval installations.

Both previous NRC reports urged that higher priority be given to activities that facilitate the full transition of responsibility to Russia for securing material at Russian civilian facilities in an internationally acceptable manner.[2] Maintaining adequate protection of fissile material must become the full technical and financial responsibility of Russian organizations as soon as possible.[3] This transfer of responsibilities has been defined by the NRC committee responsible for this study as *indigenization*, with the desired result being an enhanced, self-sustaining Russian MPC&A system that will secure the vast stockpiles of Russian HEU and plutonium at a high level of security. The system should include a legal and regulatory framework that can be sustained in Russia, technical approaches that are consistent with that framework, effective enforcement mechanisms, and adequate human and financial resources to support the entire system. Clearly, the transition to a self-sustaining system will be greatly facilitated if indigenization objectives are incorporated into the cooperative efforts to upgrade MPC&A systems throughout Russia.

ORIGIN OF THE STUDY

In early 2002, the NRC and the Russian Academy of Sciences (RAS) identified the process of indigenizing MPC&A responsibilities in Russia as a priority topic of global significance that should be addressed through interacademy efforts. In view of the importance and urgency of the topic, the Nuclear Threat Initiative, a private foundation, generously provided the funds for this study. In Moscow, Rosatom (then Minatom) joined the RAS in welcoming this assessment conducted by the NRC committee.

The specific charge to the NRC committee responsible for this assessment was as follows:

> The National Academies will conduct consultations with United States and Rus-

[2]The recommendations in the two previous NRC reports concerning indigenization are set forth in Appendix B. Unfortunately, some have not yet been implemented and they deserve continued attention in the United States and the Russian Federation.

[3]While there is no agreed-upon international standard of adequate protection of fissile material, the International Atomic Energy Agency does provide standards and guidelines, which, if followed, may serve to increase confidence in the protection of materials in the Russian Federation and other countries.

> sian officials and specialists and prepare a report that addresses the issue of indigenization of capabilities for protection, control, and accounting of nuclear materials during the phase-out, and after the completion, of DOE's involvement in such programs in Russia. This project will identify approaches that will encourage the Russian government and Russian research institutes to ensure that upgraded MPC&A systems that have been installed, including systems installed through cooperative efforts with DOE, are operated in an effective manner for the indefinite future, taking into account the likelihood of continued financial shortfalls.[4]

As discussed throughout the report, the NRC committee recognized that fully indigenized MPC&A systems in Russia will include elements of DOE-installed upgrades, adjustments to those upgrades, and entirely new Russian-initiated elements. Therefore, the charge to the committee has been interpreted accordingly.

SCOPE OF THE ASSESSMENT

While this assessment has focused on indigenization, it is not possible to separate the initiation of indigenization efforts from current efforts to install MPC&A upgrades at Russian facilities. On the contrary, it is essential to integrate the process of indigenization into the design and implementation of current joint projects at both the national and facility levels in Russia. Therefore, the NRC committee gave considerable attention to past and current cooperative activities to install MPC&A upgrades (see Appendix D for: (1) the legislative basis for U.S.–Russian cooperation in this area; (2) U.S. legislation regarding transition to full Russian managment of MPC&A systems; and (3) a description of the DOE program).

Several members of the NRC committee had participated in the two previous NRC studies. As part of these three projects, those members made three visits over a period of eight years to several Russian facilities involved in cooperative MPC&A activities and therefore have a good basis for assessing the program from the working level. This experience has better positioned them to comment on the process and effectiveness of past approaches, as well as to discuss current activities and future plans.

Although indigenization is also important in other countries where efforts to improve existing MPC&A systems are proceeding, particularly countries of the former Soviet Union, this study focuses specifically on Russia. The committee believes, however, that many of the recommendations and observations in this study are also relevant to programs in other countries.

Approximately 50 Russian entities currently participate in the cooperative

[4]See Appendix C for the biographies of NRC committee members.

MPC&A program. Some of these facilities are among the most sensitive in the Russian nuclear weapons research and development complex, and others are at sensitive Russian naval installations. A number of Russian facilities are located at distant locations where once few foreign visitors ventured and where Russian specialists had limited exposure to developments outside their own country. There are also facilities in large urban areas, including universities and civilian research centers, where nuclear safety and security are of critical importance to the nearby residents of the cities.

This study addresses the control of material that is not incorporated in weapons. Although protection of weapons is of crucial importance, it raises issues that are distinct from those surrounding the security of weapon-usable material. Similarly, even though spent nuclear fuel with low burnup and/or long storage time may not be self-protecting and may also pose proliferation threats, spent fuel has not been considered. These types of materials deserve special attention in subsequent studies.

Finally, the study does not address the protection of, and accounting for, material that could be used for radiological terrorism, such as ionizing radiation sources or radioactive waste. Such material could be packed into terrorist devices that use conventional explosives or are otherwise designed to release radioactivity into indoor or outdoor environments. This threat is being separately considered in studies by the NRC and other organizations.

RELATED STUDIES BY OTHER ORGANIZATIONS

Many Russian, United States, and international institutions have prepared reports that directly or indirectly address the MPC&A cooperative program. The most extensive reports on this topic have been prepared by DOE and Rosatom themselves. However, with a few exceptions, such as summary reports to Congress and reports at international meetings, they are not available to the public because they typically contain sensitive security-related information.

As recent public reports by governmental and nongovernmental organizations indicate, there is an increasing interest in indigenization in Washington and Moscow. Some disagreement remains, however, about how best to identify and characterize this process. DOE has recently defined the term *sustainability* as "the assurance of effective long-term operations of MPC&A systems."[5] Further, as indicated in Appendix E, DOE has identified several characteristics of sustainability.[6] There is concern among members of the committee that this term may suggest that U.S.-installed upgrades must be maintained as installed and that

[5]Official definition provided by DOE to the committee in April 2004.

[6]The committee does not necessarily endorse these characteristics, but rather offers them as one approach to the challenge of indigenization.

the draft laws and regulations prepared under DOE auspices must be adopted nearly verbatim, providing little opportunity for Russian adaptations. Moreover, use of the term *sustainability* may raise the expectation among some Russian leaders that a continuing flow of U.S. funds will be available to maintain systems. This discussion of terminology underscores the need for a jointly conceived and implemented MPC&A indigenization plan.[7]

ACKNOWLEDGMENTS

The RAS played a critically important role in facilitating this assessment. Several senior RAS officials provided valuable insights concerning the importance and effectiveness of the cooperative program. NRC committee visits and consultations in Russia would not have been possible without the active support of the RAS. Special appreciation is extended to the RAS officials who took the initiative to invite the committee to visit their nuclear research facility in Gatchina near St. Petersburg and to consult with their security experts in Moscow even though these activities were not on the initial list of requested visits.

Appreciation is also extended to officials of Rosatom and the Federal Service for Environmental, Technological, and Nuclear Oversight (Rostekhnadzor, formerly known as Gosatomnadzor), specialists at seven Russian institutes, and specialists from non-governmental organizations (NGOs) and other organizations in Russia who shared their insights with the NRC committee. In the United States, many officials and specialists devoted considerable time and effort to supporting this study, and appreciation is also expressed to them. (Appendix F includes a list of the organizations that arranged visits and consultations for the committee.)

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review was to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

We wish to thank the following individuals for their review of this report:

[7]DOE and Rosatom have held workshops on sustainability. The purpose of these workshops was to exchange ideas, concepts, and best practices on how to sustain MPC&A systems installed by the joint program. Materials from the workshops were provided to the committee and are available through the National Academies' public access file.

Evgenii Nikolaevich Avrorin, All-Russian Scientific Research Institute of Technical Physics; Gary Bertsch, University of Georgia; Matthew Bunn, Harvard University; Rose Gottemoeller, Carnegie Endowment for International Peace; Siegfried Hecker, Los Alamos National Laboratory; Valentin Ivanov, Russian State Duma; Igor Khripunov, University of Georgia; Kenneth Luongo, Russian-American Nuclear Security Advisory Council; Gennady Pshakin, Institute of Physics and Power Engineering; Lars van Dassen, the Swedish Nuclear Power Inspectorate; and Frank von Hippel, Princeton University.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Robert Frosch, Harvard University, and John White, Harvard University. Appointed by the NRC, they were responsible for ensuring that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

William Happer
Chair
Committee on Indigenization of Programs to Prevent Leakage of Plutonium and Highly Enriched Uranium from Russian Facilities

Glenn E. Schweitzer
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Office for Central Europe and Eurasia

Contents

Summary

THREAT OF A NUCLEAR CATASTROPHE

The terrorist attacks in New York and Washington on September 11, 2001, and subsequent bombings in Moscow, Madrid, Istanbul, Bali, London, and elsewhere have vividly demonstrated the determination of terrorist groups to cause large numbers of civilian casualties and massive damage, even if their acts involve suicide missions. Should terrorists acquire the capability to detonate a nuclear device in a major urban area, recent events clearly suggest that they would attempt to do just that. Such an attack could kill or maim hundreds of thousands of city residents and spread radioactive fallout for hundreds of miles.

Thus far, the acquisition of such a capability by terrorist groups has been constrained primarily by the difficulty these groups face in obtaining sufficient quantities of highly enriched uranium (HEU) or plutonium that could be fashioned into crude nuclear weapons.[1] The protection, control, and accounting of these materials—and particularly control over the significant quantities that exist in Russia—are imperative to mitigating the threat of nuclear terrorism.

Protection of HEU is the most immediate concern because there are larger quantities of it in Russia than plutonium, it is more widely dispersed geographically, and it is more easily incorporated into a nuclear device. Plutonium is also a potential target for terrorists. Therefore, both materials must be stringently controlled.

[1]For the purposes of this report, HEU consisting of 20 percent or more of uranium-235 or separated plutonium is referred to as weapon-usable material.

Materials protection, control, and accounting (MPC&A) systems are designed to prevent unauthorized removal of weapon-usable material from safekeeping. This report addresses how future funds provided by the United States and other international partners can be used most effectively in completing the task of upgrading MPC&A systems in Russia and in encouraging Russian organizations to develop and implement their own programs and procedures for indefinitely maintaining adequate security of weapon-usable material. Russia has a very large percentage of the world's accumulation of weapon-usable material. Global security is thus dependent on effective MPC&A systems there. Russia also has a self interest in these upgrades because of the danger that sub-national groups operating in Russia might turn to nuclear weapons.

During the past several years, the number of reported thefts and attempted thefts of weapon-usable material from Russian facilities has declined, although there is no basis for judging the number of unreported attempts or the number of undiscovered successful thefts.[2] Security enhancements installed through the U.S.-Russian cooperative program to protect weapon-usable material may have played a role in limiting the number of incidents.

The Russian government is clearly concerned about the security of nuclear facilities, as evidenced by the prompt dispatch of additional security personnel to these facilities following the destruction of two Russian airliners by suicide bombers and the seizure by terrorists of 1,200 hostages at a Russian school in Beslan, near Chechnya, in mid-2004. At the same time, this general concern among Russian experts about terrorist attacks on nuclear facilities seems to focus on the prevention of sabotage and on the importance of guards and perimeter defenses. It does not reflect adequate priority for using modern methods to assist in preventing the theft of material.

Building on the growing concern about terrorist acts on Russian soil, Russia should intensify its efforts to secure its weapon-usable material both in the short term and the long term. The safety of the world is directly linked to the security of nuclear material in Russia and indeed in all countries. Despite twelve years of U.S.-Russian cooperative programs, weapon-usable material in Russia is still not as well controlled as it should be, especially in light of increasingly aggressive terrorist activities in the country. If protection of this material is not urgently upgraded, worst-case scenarios of catastrophic terrorism could become a reality.

There are an estimated 600 tons of weapon-usable material in Russia that are not in weapons. During the past decade, the U.S. Congress has appropriated more than $1.5 billion for U.S.-Russian efforts to upgrade MPC&A systems that pro-

[2]In a 1999 interview published in *Izvestiia*, V. B. Ivanov, then Deputy Minister of Atomic Energy of the Russian Federation, stated that during the Soviet period there were two cases of attempted illegal access to nuclear materials; between 1992 and 1995, 28 cases were reported; and after 1995, three or four cases were reported.

tect this material, but the job is still not finished. The amount of additional funding from abroad that will be required to upgrade protection of all stocks of weapon-usable material depends on the ability of Russia to assume full responsibility for protecting its own material. This report assumes that there will be significant shortfalls in Russian contributions in the near term. As a result, the U.S. effort in Russia must continue.

The National Research Council committee has defined *indigenization* as the process of making the transition from the U.S.-Russian cooperative program financed largely by the Department of Energy (DOE) to an MPC&A program managed, maintained, and financed by Russia that ensures the security of weapon-usable material at a level that is necessitated by the threat of international terrorism and is consistent with internationally acceptable practices. Indigenization is the focus of this report.

DIVERGING PRIORITIES

Both the U.S. and Russian governments are vitally concerned about the increasing threats of terrorists obtaining weapons of mass destruction. Both countries have made strong commitments at the United Nations and at G-8 summit meetings to help prevent such a development. The U.S. government places high priority on preventing terrorist groups from acquiring weapon-usable material in Russia that could lead to nuclear detonations anywhere in the world. On the other hand, the Russian government is primarily concerned with: (1) preventing sabotage of its facilities that house dangerous materials; (2) ensuring the safety and security of its stockpiles of chemical weapons; (3) dismantling its nuclear submarines; and (4) preventing the theft of its radioactive material for use in dirty bombs—measures that could prevent near-term catastrophes in Russia. As a result, Russia's actions to meet its own national security priorities are not fully aligned with U.S. priorities.

In 1996, the Russian government enacted the *Law on Funding Sites and Facilities of the Highest Radiological and Nuclear Hazard,* which should have provided a strong basis for cooperation. However, the Russian government has not moved as quickly as the U.S. government would like in implementing MPC&A upgrades, nor has it taken adequate steps to provide financial support for MPC&A activities. Based on numerous discussions in Russia, we conclude that Russian officials and specialists simply do not share the high level of concern regarding the vulnerability of material to theft from their facilities as is held by U.S. experts.

Meanwhile, the technical, regulatory, and economic considerations surrounding the cooperative MPC&A program have changed significantly during the past decade. For example, twelve years of cooperation have fostered a considerable degree of mutual respect and understanding among officials and specialists from the two countries while enabling Russian experts to become acquainted with

Western approaches to MPC&A. The Russian government has imposed new regulatory requirements on activities at nuclear facilities, including those associated with the protection of weapon-usable materials. All the while, the Russian economy has been slowly recovering, and the World Bank predicts continued growth. Salary levels at nuclear facilities have gradually improved. But at many facilities, they remain low, even by Russian standards.

The cooperative MPC&A program has been slow to adjust to this new environment. For example, despite the significant increase in Russian technical capabilities, DOE continues to dominate the selection of MPC&A upgrade priorities and approaches. Indeed a contract administration culture has emerged in DOE that too often regards Russian counterparts as contractors whose role is to comply with U.S.-determined checklists. Also, new Russian regulations reflect approaches not always consistent with DOE approaches. For example, Russian regulations often require the protection of entire facilities with comprehensive perimeters. In contrast, DOE has frequently given low priority to the Russian requirement for stringent protection of facility perimeters. Finally, despite the improved economic situation, the Russian government has shown few signs of increasing its financial contributions to improving MPC&A systems.

Development of a U.S.-Russian partnership based on shared priorities and common approaches is a critical step toward MPC&A indigenization. Unless Russian officials and managers fully embrace the importance of upgraded systems, such as those that are installed through the cooperative program, they will have little incentive to maintain adequate MPC&A systems once they themselves must pay for their maintenance and expansion. Clearly, unless Russian regulatory requirements codify the approaches that are adopted, the likelihood of effective indigenization is low. In an era of terrorism, each side should show greater flexibility both in sharing the financial burden, and in developing common and mutually acceptable approaches toward adequate protection of weapon-usable material.

PREPARING FOR INDIGENIZATION

There have been many notable successes in the cooperative program. Overall, material security at many facilities has greatly improved. For example, the projects to enhance security of fresh nuclear fuel in the possession of the Russian Navy have been very well implemented. Substantial modifications to improve MPC&A systems at the nuclear weapons centers in Snezhinsk and Sarov have been reported. The programs at Luch and at the Research Institute for Nuclear Reactors in Dimitrovgrad to blend down HEU from several other facilities have provided income streams for enhancing MPC&A while reducing the quantity of HEU in Russia. The MPC&A training program at the Institute of Physics and Power Engineering in Obninsk now relies almost entirely on Russian instructors, even though the training is still subsidized by DOE. At least one Russian facility,

however, is prepared to pay the total costs for training its personnel at Obninsk. Upgraded MPC&A systems at several storage facilities are operated by Russian personnel, and in some cases Russian management has assumed responsibility for the costs associated with maintaining them. The security of material in transit has also been significantly improved through upgrading the security characteristics of rail cars and trucks.

Further, the Russian government and private sector have developed new capabilities to provide equipment and services in support of MPC&A activity, although more needs to be done in this area. The Russian Academy of Sciences has begun committing its own funds to improving MPC&A at its single reactor site and intends to upgrade all security aspects with or without international assistance. Significantly, DOE prepared its first sustainability guidelines.[3] In addition, the Russian Federal Agency for Atomic Energy (Rosatom) and DOE agreed during the 2004 meeting of the Joint Coordinating Committee to establish a working group to develop a joint sustainability strategy.

Even taking into account such progress, the cooperative program has moved very slowly in bringing hundreds of tons of weapon-usable material under an acceptable level of security. Rapid progress is essential in confronting the terrorist threat. It is also important in setting the standard for indigenization. Unless the completion of security upgrades is made a priority by both sides, there will be little priority placed on indigenization. According to DOE, security upgrades have been applied to about 50 percent of the approximately 600 tons of weapon-usable material in Russia;[4] this is in part due to the fact that not all significant Russian facilities participate in the DOE program. This is far short of the goal of 100 percent, even after a decade of concerted effort. The former Secretary of Energy, Spencer Abraham, committed to achieving the 100 percent goal by 2008, two years ahead of an earlier schedule. But without a comparable Russian commitment, this goal will not be achieved.

The reasons for lack of faster progress are numerous. They include Russian confidence in the adequacy of existing systems, at least for the time being, and complications over U.S. access to some sensitive facilities. The changing DOE program management over the past decade has also impeded progress. Likewise the administrative reform of the Russian government in 2004 hindered progress for a period of time. In addition, there is continuing concern within DOE and the Government Accountability Office (GAO) as to appropriate use of contract funds in Russia. This has led to a practice of issuing small contracts that consume as much time and energy on both sides as large contracts that cover a greater number of activities. Concern about criticism from the GAO has made DOE cautious indeed.

[3]See Appendix E for an excerpt of these guidelines.

[4]These figures were provided to the committee by DOE in January 2005.

An important area that deserves much greater attention by DOE and Rosatom is accounting for material. At some facilities, measured physical inventories have yet to be completed, and databases are incomplete. Although each Russian facility is required by regulation to conduct an annual accounting of material, often the records and reports lack many significant details. While progress is being made in developing a national accounting network, this effort is many years behind the schedules set in the 1990s.

Prompt adjustments in the program to respond to the foregoing concerns are very important as the threat that terrorist groups might attempt to penetrate existing security structures increases. This report sets forth a number of recommendations regarding improvements in the existing and future cooperative program. Most of the suggestions not only address near-term concerns but also, if implemented, would facilitate the transfer of responsibility for maintaining adequate MPC&A systems to the Russian government and to managers of Russian facilities.

THREE PILLARS OF INDIGENIZATION

An indigenized Russian MPC&A program that meets levels of international acceptability over the long term must rest on three pillars: (1) a strong and unwavering **political commitment** by the Russian government to maintaining a high level of proven security measures protecting weapon-usable material; (2) **adequate resources** at the facility level to fulfill such a commitment; and (3) approaches to installing MPC&A systems that are not only technically sound but also **fully embraced by Russian managers and specialists**. The following steps could help establish these pillars.

Political Commitment

Few Russian officials deny the importance of MPC&A systems. But many are not convinced that Russia must modernize or even replace the traditional Soviet security systems for protecting nuclear material. These systems relied in large measure on gates, guards, and guns, together with primitive accounting systems—methods that were effective within the closed Soviet society.

It is essential to develop strong Russian champions for MPC&A improvements. At the highest levels, the Russian president, the prime minister, and leading members of the Duma should be informed at international meetings of Western views of the vulnerabilities of Russian facilities and should be encouraged to articulate the importance of modern MPC&A systems wherever weapon-usable material is located. At the implementing level, Rosatom, the Federal Service for Environmental, Technological, and Nuclear Oversight (Rostekhnadzor), the security services, and other responsible bodies should consider MPC&A systems of high priority and should reflect this priority in their policy and budgetary deci-

sions. Also, using interagency and other channels, the Russian Security Council and the Ministry of Foreign Affairs should continue to emphasize the international significance of greater Russian attentiveness to enhanced MPC&A systems.

Likewise, committed leaders within the U.S. government have many channels of interaction with Russian counterparts, which they should utilize to convey the imperative of effective MPC&A systems. The President and his advisors should repeatedly stress the importance of protecting weapon-usable material in their meetings with Russian counterparts. DOE and other departments need to reinforce this importance at the next level of interactions and urge their Russian counterparts to share vulnerability assessments with senior officials in a manner consistent with Russian laws on information security. Of special importance is the role of the U.S. Nuclear Regulatory Commission (NRC) as an advocate of modern MPC&A systems. The NRC is restricted in the use of its own funds for international activities. Therefore, the overall program would benefit significantly if DOE provided increased financial support for NRC to work closely with Rostekhnadzor in promoting increased security over weapon-usable material. DOE should also support efforts of nongovernmental organizations in both countries to continually raise the importance of MPC&A issues.

Resources

An international MPC&A Indigenization Fund should be established within the framework of the G-8 global partnership to provide financial support for MPC&A improvement projects proposed by Russian facilities that have demonstrated their commitments to robust MPC&A systems. While the size and details of the Fund must be based on careful analyses of technical and financial needs and then on negotiations among all concerned parties, the following characteristics may serve as a basis for discussion:

- The Fund would have an initial investment of $500 million to dispense to Russian institutes and other facilities over a period of ten years. The annual outlay would average $50 million. The interest earned on the initial investment would be used to cover the overhead costs of operating the Fund.
- The contributions to the Fund would include the following: $200 million from the United States, $100 million from Russia (in cash, not in kind), and $200 million from other G-8 partners. The Russian contribution would support particularly sensitive projects, and the monitoring and auditing of these projects would be carried out by Russian specialists using the guidelines of the Fund.
- The Fund would be managed by a new intergovernmental entity taking into account the experiences of the International Science and Technology Center in Moscow and other intergovernmental mechanisms that have been effectively used to provide international funds to Russian nuclear facilities.

• The Fund would provide financial support on a competitive basis in response to Russian proposals for MPC&A improvement projects, perhaps up to $1 million or more for each multiyear project involving construction activities. Smaller levels of funding would support training, replacement parts, and accounting software for example. Specialists from laboratories of DOE, Russia, and the other G-8 partners would assist in reviewing the soundness of the proposals and in monitoring implementation of approved projects.

The Fund would embody three approaches that are essential aspects of indigenization: (1) Russian facilities would propose projects that respond to their priorities in complying with Russian regulations; (2) an intergovernmental governing board would approve projects and ensure that they are consistent with international practice; and (3) the Russian government, as an investor in the Fund, would play a more active role in promoting the importance of modern MPC&A systems within Russia and internationally.

In short, the Fund would enable Russian facilities that are proceeding effectively toward indigenization to obtain funding allowing the completion of the indigenization process and the maintenance of technical capabilities over the long term. As a first step, international experts, including Russian specialists, should prepare a detailed analysis of the technical and budgetary requirements of an effective MPC&A system, thereby providing the foundation for international negotiations.

In addition to this new initiative, Congressionally-appropriated funds should continue to support current DOE efforts. However, there should be some modifications to the program, as suggested below. As all weapon-usable material at specific facilities comes under an acceptable level of security and as the facilities move along realistic and timely paths toward full indigenization, they would become eligible to apply for support from the Fund. As a result, the size of the DOE program would decline accordingly. Those facilities with security shortfalls that could not be corrected with Russian resources or resources of the Fund would continue to cooperate directly with DOE until the deficiencies had been resolved.

Encouraging Russian Buy-in of Technical Approaches

DOE has patterned its technical approaches in Russia after those long used in the United States and other Western countries. This is appropriate as long as there is flexibility to accommodate special needs and capabilities in Russia. Within this framework, there are several steps that can be taken to accelerate the process of upgrading security and to facilitate indigenization. Specifically, DOE should

• Encourage Russian institutions to give higher priority to improving their own accounting systems. As noted above, upgrades of accounting systems have

lagged far behind improvements of physical protection. Nuclear materials accounting systems should be designed and built in Russia to the extent possible. If possible, they can be based on imported, global tools and database software adapted to Russian needs.

- Encourage Russian counterparts to give greater attention to accelerating the development of a modern regulatory framework by establishing their own priorities among the many dozens of proposed new laws, decrees, and regulations that are being developed jointly in the area of materials protection, control, and accounting. Regulatory enforcement should also be strengthened.
- Continue to strengthen the capabilities of both the public and private sectors in Russia to produce and service MPC&A equipment. In this regard, emphasis should be given to sturdy equipment that is relatively inexpensive to operate and maintain.

CROSSCUTTING PRINCIPLES FOR MPC&A COOPERATION

Adherence to the following principles is essential if the cooperative MPC&A program is to achieve its full potential and lead to indigenization. They underlie the findings and recommendations of the committee.

Russia should be treated as an equal partner, not as a recipient of foreign aid.

Russian specialists should lead the design of MPC&A systems installed at Russian facilities, the selection of equipment for these systems, and the testing and validation of the effectiveness of these systems. Russian and U.S. experts should therefore be encouraged to see one another as partners in the process, with complementary skills and expertise.

Consolidating weapon-usable material would significantly reduce the amount of material at risk and should reduce security costs.

All governments supporting MPC&A activities in Russia, and the Russian government itself, need to give greater priority to: (1) consolidating weapon-usable material at fewer facilities; (2) consolidating material at fewer locations within facilities that retain material; and (3) reducing the amount of material stored at Russian facilities by converting HEU to less dangerous material.

Also, DOE should give special attention to assisting Rosatom and other organizations in removing fuel from obsolete research reactors that required weapon-usable material, converting operating reactors that use HEU to reactors dependent on low enriched uranium (LEU), and shipping excess HEU to appropriate storage sites.

Continued attention to the development of a nuclear security culture is essential to the indigenization of MPC&A programs.

DOE has made a good start in creating greater awareness among Russian officials and specialists of the importance of protecting nuclear material through education, training exercises, exchange of information and best practices, and incentive programs. DOE should continue to give these programs special attention.

In sum, Russia and the United States have unique nuclear experience and they have an obligation to use that experience to prevent a nuclear catastrophe from occuring anywhere in the world. The first priority for each country therefore, is to ensure that weapon-usable material in its own possession is under adequate security. The cooperative MPC&A program provides an important mechanism for enhancing the security of material throughout the Russian nuclear complex. But such cooperation will be limited in its effect unless Russia continues to maintain adequate security systems in the decades ahead. If they fail, the result could be a nuclear disaster. The job initiated through the cooperative program must be finished correctly, rapidly, and in a manner that facilitates the transition of full responsibility to the Russian Federation.

Fortunately, since this study was initiated in 2003, the DOE management team has devoted increased attention and resources to issues of indigenization, a positive trend that should be continued and expanded.

1

Responding to the Threat of Nuclear Terrorism

THREAT OF A NUCLEAR CATASTROPHE

The terrorist attacks in New York and Washington on September 11, 2001, and subsequent bombings in Moscow, Madrid, Istanbul, Bali, London, and elsewhere have vividly demonstrated the determination of terrorist groups to cause large numbers of civilian casualties and massive damage even if their attacks require suicide missions. Should terrorists acquire the capability to detonate a nuclear device in a major urban area, recent events strongly suggest that they would attempt to do just that. Such a nuclear catastrophe could kill or maim hundreds of thousands of city residents, with radioactive fallout extending hundreds of miles from the site of the detonation.

The interest of terrorist groups in obtaining nuclear devices can be traced at least to the mid-1990s, when the Aum Shinrikyo cult in Japan explored the possibility of acquiring uranium for possible use in terrorist attacks. More recently, documents with primitive sketches of nuclear weapons obtained from al Qaeda camps and statements by al Qaeda leaders suggest that this terrorist network has also considered the possibilities of nuclear terrorism. At present, however, there is no publicly available information indicating that a terrorist group, operating independently of a government, has made significant strides in developing a nuclear device. Indeed, constructing a nuclear weapon is not an easy task for terrorists, even if they possess the required material. But this possibility cannot be precluded as terrorists become more skilled in the applications of nuclear technology.

The recent revelations of an international black market in nuclear technolo-

gies operated by the Pakistani scientist A. Q. Khan have blurred the distinction between governmental and nongovernmental activities and highlight the urgency of securing weapon-usable material. Further, thwarting access to weapon-usable material by subnational or international groups also serves to prevent access to such materials by irresponsible states. Both dangers deserve priority attention.

Thus far, the acquisition of a nuclear weapons capability by terrorist groups has been constrained primarily by the difficulty these groups face in obtaining sufficient quantities of highly enriched uranium (HEU) or plutonium that could be fashioned into crude nuclear weapons.[1] The protection, control, and accounting of these materials remain imperative to mitigating the threat of nuclear terrorism.

Russia, along with the United States, has by far the world's largest inventories of weapon-usable material. Since the disintegration of the Soviet Union, incidents of theft and attempted theft of small quantities of weapon-usable material from Russian facilities have been occasionally reported. In each case, the quantities of material involved have been far less than the amount required for a nuclear weapon.[2] The number of reported incidents of attempted theft of weapon-usable material in Russia has been declining but there is no basis for judging the actual number of unreported attempts or the number of successful thefts.[3] Upgraded physical protection and accounting systems, which are the focus of this report, may have contributed to the reduced number of attempts to steal material. Further, the cooperative materials protection, control, and accounting (MPC&A) program has involved thousands of Russian participants and has certainly heightened sensitivities to the possibility and consequences of thefts.

In 1996, another NRC committee visiting Moscow was informed that there had been 23 attempted thefts prior to that time. However, these attempts related only to a limited number of Russian facilities. While in Russia in 2003, the committee was informed of three unsuccessful attempts to steal weapon-usable material from Russian facilities since 1996. Each effort was foiled by the Federal Security Service (FSB) within the facility or in the immediate vicinity of the facility. Reports of a smaller number of incidents are included in the database of

[1]For the purposes of this report, HEU consisting of more than 20 percent of uranium-235 or plutonium that has been separated from fission products and other actinides is referred to as weapon-usable material.

[2]The amount of material required to construct a crude nuclear device is often cited as 8 kilograms of plutonium or 25 kilograms of U-235 contained in HEU. The committee considers these estimates to be reasonable. The exact amount required depends on a variety of factors including the sophistication of the weapon design and the exact characteristics of the material. The amounts involved in the reported incidents of attempted material theft have usually been much less than these amounts.

[3]In a 1999 interview published in *Izvestiia*, V. B. Ivanov, then deputy minister of atomic energy of the Russian Federation, stated that during the Soviet period two cases of denied access to nuclear materials were reported; between 1992 and 1995, 28 cases were reported; and after 1995, three or four cases were reported.

the International Atomic Energy Agency. Although the record of actual and attempted thefts is unclear, the security of weapon-usable material in Russia is of major concern; and upgrading inadequate security systems to prevent thefts is the objective of the long-standing U.S.-Russian cooperative program on MPC&A systems in Russia.

In general, HEU is more widely available in Russia and arguably less protected in some cases than plutonium. Plutonium is concentrated in a limited number of institutes and enterprises, with most of the stockpiles in relatively secure locations in closed cities. But not all HEU is at high risk of theft, nor is all plutonium at low risk. For example, HEU from dismantled weapons at Mayak and Tomsk-7 is probably more secure than plutonium at some institutes in and near Moscow. Poorly secured plutonium metal may be a more serious concern than HEU in certain circumstances (such as that comprising only 21 percent U-235 that is diluted in a fuel matrix and stored in a heavily shielded reactor building).

While terrorists may find it easier to fabricate a weapon with HEU than plutonium, the manufacture of a weapon based on plutonium is not beyond the reach of technically advanced terrorists. Further, as previously noted, proliferation concerns extend beyond terrorist groups to irresponsible governments with nuclear ambitions, and some have the technical capabilities to develop crude devices based on either plutonium or HEU. Thus, the optimum strategy for protecting weapon-usable material in Russia, and indeed in all countries, is to address the problems posed by HEU and plutonium in parallel. The Russian MPC&A program places equal emphasis on the protection of HEU and plutonium.

In the late 1990s, the U.S. Department of Energy (DOE) highlighted the following MPC&A deficiencies in Russia that were attributed to the lingering Soviet legacy and to economic difficulties that continue at some sites today:[4]

- lack of unified physical protection standards and inadequate defenses of buildings and facilities within site-perimeter fences
- lack of portal monitors to detect fissile material when leaving a site
- inadequate central alarm stations and inadequate 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 and determine when they have occurred
- inadequate measurements of waste, scrap, and hold-up nuclear materials

[4]NRC. 1999. *Protecting Nuclear Weapons Materials in Russia*, National Academy Press, Washington, D.C., p. 10.

during processing, and inadequate accounting of transfers of nuclear materials between facilities

- antiquated tamper indicating devices (seals) on nuclear material containers

The chain of security is no stronger than its weakest link, and *all* Russian facilities where HEU and plutonium are located should have robust security systems. In Russia, where the economy is still a long way from complete recovery and where corruption within the security services has been repeatedly criticized by the Russian president, the importance of modern MPC&A systems cannot be overstated. The rapid deployment of additional security personnel to nuclear facilities following the destruction of two Russian airliners by suicide bombers and the hostage-taking at a school in Beslan near Chechnya in September 2004 underscores the heightened concern over nuclear terrorism within the Russian government. That concern seems to focus on sabotage by Chechen militants and on the importance of guards and perimeter defenses. But the need to strengthen security systems so that neither facilities nor material can be reached, even with the help of disenchanted employees (insiders) or corrupt officials, is clear.

THE COOPERATIVE PROGRAM

Given the potentially catastrophic consequences of the detonation of a nuclear weapon in a populated area, DOE has been conducting a cooperative MPC&A program with Russian counterparts for more than a decade (see Table 1-1). The program is structured around the following well-accepted security concepts:[5]

- *physical protection systems* provide for the detection of any unauthorized penetration of barriers, portals, and other security measures surrounding material, and trigger an immediate response to such penetrations, including the use of force if necessary
- *material control systems* prevent unauthorized movement of material and provide for the prompt detection of theft or diversion of material
- *material accounting systems* ensure that all material is accounted for, enable the measurement of losses, and provide information for follow-up investigations of irregularities

In principle, these concepts seem well accepted in Russia. Full implementation, however, continues to require more extensive efforts by both U.S. and Russian experts.

The initial projects in the cooperative program to upgrade MPC&A systems

[5]Ibid, p. 12.

TABLE 1.1 Components of an MPC&A System Within a Facility

	Physical Protection	Control	Accounting
Detection and assessment (sensors, alarms, assessment systems such as video)	X	X	
Delay (barriers, locks, traps, booths, active measures)	X	X	
Response (communications, interruption, neutralization)	X	X	
Response team	X		
Entry-and-exit control (badges, biometrics, nuclear material detectors, metal detectors, explosive detectors)	X	X	
Communications and display	X	X	X
Measurements and measurement control (weight, volume, chemical analysis, isotopic analysis, neutron, gamma, calorimetry)		X	X
Item control (barcodes, seals, material surveillance)		X	
Records and reports			X
Inventory		X	X
Integrated planning, implementation, and effectiveness evaluation	X	X	X
Supporting functions (personnel, procedures, training, organization, administration)	X	X	X

SOURCE: NRC. 1997. *Proliferation Concerns: Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union*, National Academy Press, Washington, D.C., p. 8.

in Russia began in 1993, and related activities have continued until the present (see Appendix G). More than $1.5 billion dollars have been appropriated to DOE to support this program since 1993, initially through the DOD-led Nunn-Lugar program and then directly to DOE. Appendix H indicates appropriations from FY1999 to FY2003 as well as Congressional funding for FY 2005 and projected requests for FY 2006-2009. Appendix I identifies the Russian facilities that participate in the program.

WAVERING POLITICAL SUPPORT FOR MPC&A IN RUSSIA

During the past decade, the presidents of both countries have made numerous statements regarding the importance of cooperation in nuclear security, and they have reported general progress in the program. In 2004, U.S. Secretary of Energy Spencer Abraham promised that the current cooperative program to improve protection of 600 tons of weapon-usable material in Russia would be completed in 2008, two years ahead of schedule.[6] While the program may not encompass all weapon-usable material in Russia, the intended acceleration of the schedule is nevertheless a positive sign of interest by the U.S. government in moving forward with dispatch.

In general, the U.S. government has given high priority to implementation of the program. On the other hand, the Russian government gives much higher priority to other security concerns. A number of well-informed Russians consistently cited other priorities when queried by the committee during a visit to Russia in 2003. Top priorities were the safekeeping and destruction of stockpiles of chemical weapons, dismantling of nuclear submarines, and preventing theft of radioactive material that could be used in dirty bombs. Since that time, it appears that protection of nuclear power plants has also become a key security priority as terrorists grew more aggressive in Moscow and in southern Russia during the summer of 2004. These Russian priorities are all directed toward enhancing domestic security. Prevention of these catastrophes in Russia seems to be the principal concern of the Russian government. But there apparently is less concern in Russia that sub-national groups could steal weapon-usable material from Russian facilities, use the material to construct a weapon, and detonate that device in a populated area of the country.

While Russia supports U.S. efforts to upgrade protection of HEU and plutonium in Russia, the overall security concerns that drive these efforts differ among U.S. and Russian experts. This is reflected in differing approaches to security in general and upgrades in particular. To prevent unauthorized access to, and sabotage of, nuclear facilities (often considered by Russian experts to be a key threat), Russian managers emphasize perimeter security. The U.S. priority of preventing

[6]Abraham, Spencer. Washington Post. July 17, 2004. How to Stop Nuclear Terror. A19.

theft focuses more heavily on close-in security of materials. However, both perimeter security and close-in security should play a role in ensuring overall security and protection of weapon-usable material.

As a result of these different perceptions of the threat and different views on vulnerabilities of Russian facilities, the Russian government has not moved as quickly as desired by the U.S. government in implementing MPC&A upgrades. In 1996, the Russian government enacted the *Law on Funding Sites and Facilities of the Highest Radiological and Nuclear Hazards*, which should have been a strong point of departure for cooperation. However, the Russian Federal Agency for Atomic Energy (Rosatom) has allowed the cooperative program to become somewhat inflexible, with many problems inhibiting rapid progress, for example requiring strict lists of approved U.S. visitors to sites. Further, it has committed very limited amounts of Russia's own resources to the program. At the same time, while always advocating more rapid progress, the U.S. government has also been periodically inflexible, including in some areas of importance to Russian officials and managers, such as the frequency of intrusive access to sensitive facilities in Russia. Consequently, administrative impediments to cooperation have arisen on both sides, and the program has fallen many years behind schedules set forth in the 1990s.

ADAPTING TO A CHANGING ENVIRONMENT

Twelve years of cooperation have fostered a considerable degree of mutual respect and understanding among officials and specialists from the two countries, enabling Russian counterparts to become well acquainted with Western approaches to MPC&A. During that time, the technical, regulatory, and economic conditions surrounding the cooperative program have changed significantly. The Russian government has issued regulations that impose new security requirements on activities at nuclear facilities, including those addressing the protection of weapon-usable materials. In recent years, the Russian economy has been slowly recovering, and the World Bank predicts continued growth. Salary levels at nuclear facilities remain low, however, despite gradual improvement.

Despite the significant increase in Russian technical capabilities, DOE continues to dominate the selection of MPC&A upgrade priorities and approaches at specific sites. With few exceptions, DOE managers determine the size and content of the contracts with Russian institutions; these contracts are the primary mechanism for implementing the MPC&A upgrade program. Although Russian specialists participate in discussions to determine priorities and contracts, they are at a great disadvantage since DOE controls the funding and does not hesitate to use this control in insisting that its approach be followed. In short, within DOE, a contract administration culture has emerged that too often regards Russian counterparts simply as contractors whose role is to comply with U.S.-determined checklists.

BOX 1.1
Views of Two MPC&A Experts

"Inspections are everything. No one invests in MPC&A until the inspector is coming and is going to catch them if they don't."

SOURCE: U.S. senior official, December 2004.

"My priority is to correct the deficiencies uncovered by the inspection team sent by the Procurator's Office."

SOURCE: Director of a Russian nuclear institute, April 2004.

New Russian regulations place primacy on measures to protect entire nuclear facilities. However, until quite recently, DOE's MPC&A priorities were not consistent with these regulatory requirements. For years, DOE specialists argued that perimeter protection had only a marginal impact on security of material housed inside buildings. They have emphasized security upgrades close to nuclear materials in order to improve materials security rapidly and cost-effectively. As a result, the cooperative program did not reflect Russian regulatory requirements.

Two Russian facility managers displayed for the committee recent inspection reports of their facilities by Russian enforcement officials itemizing many deficiencies that were not being addressed through the cooperative program. The priority of the managers was to correct the deficiencies in the reports, not adjust security measures to accommodate DOE's views (see Box 1.1).

DOE security experts now acknowledge that depending on the size of the facility and the topography of a site, an external physical protection system based on an active perimeter can be an essential part of an integrated MPC&A system. Active perimeters can alert reaction forces and provide a deterrent effect against overt attacks aided by an inside collaborator. Therefore, DOE is currently reassessing the use of active perimeters for certain nuclear facilities in Russia, where their installation can improve site security. This change in approach may help alleviate the past inconsistency between DOE priorities and Russian regulations.

Finally, neither the Russian government nor facility managers have shown an interest in increasing their financial contributions to improving MPC&A systems. Indeed, the facilities have become accustomed to obtaining support from DOE, and Russian managers have few incentives for directing additional funds of their own to MPC&A unless deficiencies are found by external Russian inspectors. One well-informed and respected former facility director who currently has a prominent position within the Russian government noted that if he had received budget increases, the highest priority would have been improved bus service for the employees; MPC&A would have been very low on his priority list.

PREPARING FOR INDIGENIZATION

The committee has defined indigenization as "the process of making the transition from the U.S.-Russian cooperative program financed largely by the DOE to a program managed, maintained, and financed by Russia that ensures the security of weapon-usable material at a level that is necessitated by the threat of international terrorism and is consistent with internationally acceptable practices."

Further development of a U.S.-Russian partnership based on common approaches and greater cost sharing is an imperative step toward MPC&A indigenization. Unless Russian officials and managers fully embrace the importance of upgraded systems, such as those that are installed through the cooperative program, and indeed are willing to use their own funds to help install them, they will have little incentive to maintain adequate systems once they themselves must pay for their upkeep and operation. Additionally, unless Russian regulatory requirements are incorporated into the adopted approaches, the likelihood of effective indigenization is low. Both Russian and U.S. experts should show greater flexibility in developing approaches that adequately protect weapon-usable material and at the same time are acceptable to the other side.

Building on Existing Cooperation

Indigenization of upgraded MPC&A systems is clearly linked to ongoing DOE efforts to assist in improving these systems. Thus, a review of a few relevant experiences drawn from the current cooperation will provide important background when considering the main topic of this report.

There have been notable successes in the cooperative program. Overall, security at many facilities has been greatly improved as the following examples indicate.

The projects to enhance security of fresh nuclear fuel in the possession of the Russian Navy have been very well implemented, according to many U.S. and Russian participants in the program. Working through the Kurchatov Institute as a facilitator, DOE has been able to greatly reduce the need for intrusive access to sensitive facilities by U.S. specialists while maintaining a high level of technical performance by all concerned parties.

Substantial MPC&A system modifications have reportedly been made at the nuclear weapons centers in Sarov and Snezhinsk (see Box 1.2 for the view of a Russian participant in these activities). The committee was not able to visit these facilities and therefore cannot verify the statement.

The programs at Luch Scientific Production Association (NPO Luch) and at the Scientific Research Institute of Atomic Reactors (RIAR) in Dimitrovgrad to blend down HEU collected from several other facilities have provided NPO Luch and RIAR with income for enhancing MPC&A while reducing the quantity of

BOX 1.2
Initial MPC&A Modifications

"Thanks to a significant financial and technical contribution by the United States, integrated MPC&A systems and multi-tiered information systems have come on line in Sarov and Snezhinsk. Many U.S. and indigenous technologies have been commissioned, and numerous instruments and devices have been put into operation. These systems have been developed and operated by Russian experts whose work has only in part been paid for with U.S. assistance funds. This could very well serve as a model for other Russian facilities. The nuclear weapons centers could take on the role of general contractors implementing modifications to the MPC&A systems at such facilities."

SOURCE: Senior Russian scientist, February 2005.

BOX 1.3
Spotlight on Training:
Russian Methodological and Training Center, Obninsk, Russia

U.S. participation with the RMTC began in 1995, with the goal of enhancing Russia's state system of accounting and control of nuclear materials. In 1996, Gosatomnadzor [Russian Federal Inspectorate for Nuclear and Radiation Safety] formally acknowledged the RMTC as a central training facility for its inspectors and instructors. The RMTC was developed using a phased approach, including conducting a needs analysis to determine training requirements, joint U.S.-Russian development of training courses, and joint U.S.-Russian instruction of courses leading to a transition to all-Russian instruction at the RMTC. All 27 existing courses have transitioned to Russian instructors. Project initiatives are designed to ensure indigenous Russian methodologies and training capabilities to support long-term sustainability of the RMTC.

SOURCE: Official communication provided by DOE to the committee, September 2004.

HEU in Russia. With substantial DOE encouragement, the earnings have been applied in part to MPC&A enhancements at those two facilities.

A significant cadre of skilled Russian instructors is now available to provide MPC&A training at the Institute of Physics and Power Engineering in Obninsk (IPPE) and elsewhere (see Box 1.3).

Finally, the security of material in rail and road transit has been substantially improved through the provision and use of security-enhanced rail cars and trucks.

Even taking into account such progress, the cooperative program has moved very slowly in bringing hundreds of tons of weapon-usable material under an acceptable level of security. Not all Russian facilities with material participate in the DOE program. Further, according to DOE, the U.S.-Russian cooperative program has resulted in security improvements for about 50 percent of the approximately 600 tons of weapon-usable material in Russia, raising questions as to whether former energy secretary Spencer Abraham's goal of 100-percent coverage by 2008 can realistically be achieved.[7] This will be particularly difficult without high-level commitments on the Russian side.

The reasons for a lack of faster progress are manifold. They include, as previously indicated, Russian confidence in the adequacy of existing systems, at least for the time being, and complications over foreign access to some facilities in Russia. The frequent DOE program management changes over the past decade, the replacement of experienced DOE MPC&A managers in some cases with less experienced personnel, and a tendency on the part of remaining experienced personnel to tire of the demanding workload and travel required have also impeded progress. Likewise, the administrative reform of the Russian government in 2004 hindered efforts for a period of time. In addition, there is continuing concern within DOE as to appropriate use of contract funds, due in part to careful scrutiny by the Government Accountability Office (GAO). This has led to a practice of issuing small contracts that consume as much time and energy on both sides as issuing large contracts covering a greater number of activities. Putting in place even a small contract requires reviews and approvals in both Russia and the U.S. and typically takes several months (see Chapter 4 for additional discussion of this issue).

Rapid progress is essential in confronting terrorist threats. It is also important in setting the standard for indigenization. Unless the completion of security upgrades is made a priority by both sides, there will be little priority placed on indigenization.

Moving Toward Indigenization: Initial Success Stories

As the cooperative program continues its critical work of securing weapon-usable material in Russia, several success stories provide evidence of progress and areas upon which experts can build in the future. Specific examples of success in moving toward indigenization are as follows:

- The navy program is clearly the primary example of indigenization achievements. The Russian navy leadership seems fully committed to maintaining and operating appropriate security systems for the indefinite future.

[7]These figures were provided to the committee by DOE in January 2005.

BOX 1.4
Scientific Research Institute of Atomic Reactors (RIAR) Support for Sustainability of Upgrades at the Central Storage Facility

Comprehensive upgrades at the RIAR Central Storage Facility were completed in 1999 and have been in operation since then. To assist with sustainability of these systems, DOE has provided assistance with the procurement of spare parts, and operator and basic maintenance training. Additionally, DOE funds the security systems vendor, Eleron, to conduct biannual site-wide systems testing, maintenance, and emergency service for the site-wide system as a whole. Given these tools, RIAR has taken responsibility for the routine maintenance and adjustments necessary to ensure the continued operation of the upgraded security systems at the central storage facility. This type of service generally happens on a daily basis, with a more intensive monthly servicing.

SOURCE: Official communication provided by DOE to the committee, October, 2004.

- One Russian facility is prepared to pay the total costs for training its personnel at IPPE in Obninsk, even as it develops its own on-site training capabilities.
- According to reports received by the committee, upgraded MPC&A systems at several storage facilities are operated by Russian personnel, and in some limited cases Russian management has assumed responsibility for costs associated with maintaining them (see Box 1.4).
- The Russian government and private sectors have developed new capabilities to provide equipment and services in support of MPC&A activity, although more needs to be done in this area.
- The Russian Academy of Sciences (RAS) has developed a plan and committed initial funding to improve the MPC&A system at its single reactor site, with or without international assistance.

In addition to these critical successes by Russian experts and by joint U.S.-Russian efforts, DOE has also advanced its own indigenization projects. In 2004, DOE prepared its first sustainability guidelines. The key concepts of which are reflected in the sustainability indicators set forth in Appendix E. These guidelines provide much useful guidance for DOE teams implementing the cooperative program.

Further, Rosatom and DOE agreed during the fifth Joint Coordinating Committee meeting in August 2004 to establish a Rosatom-DOE working group to develop a joint strategy on sustainability. Such an achievement should be an important reflection of Russian support. To this end, DOE should insist that

Rosatom lead these discussions even if such an approach delays the joint effort. Additionally, the strategy should be aimed at indigenization rather than simply sustaining current efforts, as discussed below. Since Russian facility managers must ultimately implement the strategy after the DOE program ends, they should lead by setting forth their vision. Also, DOE and Rosatom would benefit from an external review of a draft strategy by knowledgeable experts. Such a review would provide an independent perspective as cooperation moves into a new phase of activities.

INDIGENIZATION AND SUSTAINABILITY: KEY COMPONENTS OF LONG-TERM SECURITY

Sustainability and indigenization are closely related terms. However, indigenization allows, and indeed requires, Russian managers to augment and modify installed systems at the facility level in order to comply with Russian regulations as they evolve. Indigenization also requires recognition that MPC&A systems must be consistent with technical and financial realities of operating within Russia. For example, Russian managers might seek to modify existing components of systems if such modifications ensure adequate protection. If an imported item needs repair, the facility manager might decide to use an alternative approach that ensures a comparable level of security rather than to search for spare parts abroad.

On the other hand, sustainability could suggest that the upgraded systems should be maintained as installed. Also, it may imply to some Russian organizations that there will be never-ending financial support from the United States to ensure that the "American" systems work. While both concepts have the same purpose—to ensure internationally acceptable levels of safekeeping of weapon-usable material for the indefinite future—indigenization recognizes that the systems ultimately must be integrated into the Russian technical and legal culture. Indigenization is therefore a broader concept which includes the entire approach to security at both the national and facility levels and is a more desirable and achievable goal.

Prompt adjustments in the cooperative program to further indigenization are important. This report sets forth a number of recommendations that should be helpful in this regard. Many of the suggestions not only address near-term concerns but also, if implemented, would facilitate the transfer of responsibility for maintaining well-designed upgraded systems to the managers of Russian facilities for the long term.

The Framework for Continued Cooperation

Past approaches have too often been characterized by technical assistance, whereby DOE is the dominant party due to its control of the funds. The new

approach to MPC&A cooperation should be one of partnership, with Russian counterparts being the lead partners. Only then will Russian support for implemented procedures be deeply internalized and self-sustaining.

In this regard, Russian specialists supported by facility managers and security personnel should now lead: (1) the design of MPC&A systems that are to be installed at Russian facilities; (2) the selection of equipment for these systems; (3) vulnerability assessment exercises (known in the United States, but not in Russia, as "Red Team" exercises) and related exercises to test and validate the effectiveness of the systems; and (4) verification that indigenization is incorporated into all activities.

Both governments need to give strong support to material conversion and consolidation activities within the MPC&A and related cooperative programs, such as the establishment of the Mayak Fissile Material Storage Facility, constructed under the DOD CTR program, and the plutonium disposition program supported by DOE. The objective is to reduce the amount of weapon-usable material stored at Russian facilities and to consolidate the remaining material into fewer facilities and fewer locations within facilities. Joint efforts to reduce the enrichment of many tons of HEU to low enriched uranium (LEU) that can be used in civilian power reactors is an excellent example of a program that can reduce MPC&A requirements at some facilities.

As to consolidation across facilities, there are few publicly reported successes—outside the navy program—in reducing the number of facilities that retain some level of material. This is largely because facilities currently benefit from having weapon-usable material even when there is no near-term or long-term need for it: the mere presence of the material often justifies retention of a significant workforce. At the same time, however, internal consolidation of material is moving forward at a number of facilities.

In this regard, DOE should continue to explore means of encouraging Russian facilities to permanently remove weapon-usable material when it is not immediately required for the operation of the facility. The provision of modern scientific equipment or laboratories may be among the incentives offered in exchange for the elimination of material. DOE should give special attention to assisting Rosatom and other organizations in removing fuel from obsolete research reactors, converting operating reactors that use HEU to reactors dependent on LEU, and shipping the excess HEU to appropriate storage sites. While the consolidation of HEU is more frequently discussed, the consolidation of plutonium also cannot be neglected.

Metrics should be developed and implemented by Russian specialists in cooperation with DOE specialists to measure progress toward the establishment of acceptable MPC&A systems at the facility level and to measure progress toward indigenization. The emphasis should be on measuring the integrated effectiveness of entire systems, not simply on counting the number of security upgrades installed. Integrated assessments should incorporate factors that mea-

sure indigenization, account for internal and external facility environments, and adjust to changing risk assessments. The sustainability indicators proposed by DOE could be helpful in this regard (see Appendix E).

Greater awareness among Russian officials, managers, and specialists of the importance of protecting nuclear material by developing a strong, modern nuclear security culture should be generated through education and training programs, training exercises, and awards. A number of Russian specialists have had temporary assignments at the International Atomic Energy Agency in Vienna, where they have been deeply immersed in training and international work emphasizing the importance of protecting material. They provide a strong cadre from which to spread awareness of the importance of MPC&A, particularly among facility leaders; and they should be encouraged to continue their outreach. The education and training programs that DOE has supported in Moscow, Obninsk, and Tomsk are also facilitating the development of a security culture. A skilled and motivated workforce at the facility level could promote effective security in parallel with efforts to strengthen and modernize security policies and could contribute to the protection of material even if Russian leaders do not give sufficient priority to MPC&A.[8]

In sum, Russia and the United States have unique nuclear experience, and they have an unequivocal obligation to use this experience to prevent a nuclear catastrophe anywhere in the world. The first priority is for both countries to ensure that the weapon-usable material in its own possession is under adequate security. The cooperative MPC&A program provides an important mechanism for enhancing security of material throughout the Russian nuclear complex, but such cooperation will be limited in duration. Unless Russia continues to maintain adequate security systems for decades into the future, the entire cooperative effort will serve no long-term purpose. The result could be a nuclear disaster.

Thus, both the U.S. and Russian governments must make protection of nuclear material a top global priority. The work initiated through the cooperative program must be finished correctly, rapidly, and in a manner that facilitates indigenization—the transfer of full MPC&A responsibility to the Russian Federation.

[8]For more information on security culture, see: Khripunov, I., D. Nikonov, and M. Katsva. 2004. *Nuclear Security Culture: The Case of Russia*, Center for International Trade, University of Georgia, Athens, Georgia.

2

The Need for Russian Champions of MPC&A

RUSSIAN INTEREST IN MODERN MPC&A SYSTEMS

Judging from many U.S.-Russian interactions, a limited number of Russian officials and specialists are deeply committed to improving the security of weapon-usable material, by giving high professional priority to modern systems for the protection, control, and accounting of nuclear matierals (MPC&A). However, they have considerable difficulty commanding political and budgetary support for MPC&A programs from Russian governmental leaders in key positions. Within Russia there are simply many competing priorities across all sectors of social and economic development in general and, as discussed in Chapter 1, in the national security sector in particular.

Few Russian officials deny the importance of MPC&A systems, but many are not convinced that Russia must replace the traditional Soviet security methods for protecting nuclear material. Those systems relied in large measure on "gates, guards, and guns" and on primitive accounting systems—methods that were effective within the closed Soviet society. These Russian officials have been reluctant to pursue change, particularly if Russia must incur the costs of replacement systems.

Indeed, based on comments from Russian specialists and officials to the committee, had it not been for the economic difficulties in Russia and the availability of United States funding in the early 1990s, participation in the cooperative MPC&A program would have been of little interest to the Russian government and to individual facilities. In the absence of immediate and substantial financial support at a time of economic hardship, the sensitivity of the topic

would have made it extremely difficult to initiate the cooperation. Fortunately, when the MPC&A program began, scientists were building trust on both sides of the ocean; it was these scientists who helped convince the governments of the proposed program's value.

The difficulties encountered in implementing a program that lacked widespread political support in Russia are understandable. Despite these circumstances, the program has nevertheless achieved a remarkable degree of success and has laid a substantial foundation for further progress. Now the challenge is to shift emphasis from economic motivation to political motivation. Russian champions are the key to responding to this challenge.

If MPC&A programs are to be truly effective in the long term, committed Russian champions must mobilize broadly based political and financial support for the current cooperative program. Without such support, upgrading MPC&A systems will be of interest only to the extent that the U.S. government is willing to finance such activities. And once upgrades have been installed, the readiness of Russian organizations to continue to support modern systems with their own funds will be less than certain.

As discussed in Chapter 1, common perceptions of the nuclear threat, of facility vulnerabilities, and of the importance of modern systems in responding to that threat are essential for making the transition from cooperation to effective indigenization. There must not only be shared perceptions among U.S. and Russian counterparts, but also common perceptions within Russia. Without strong Russian champions, an internal consensus on the importance of modern MPC&A systems and their implementation will not be achieved.

The Department of Energy (DOE) has consistently given high priority to the cooperative MPC&A program, and the Congress has steadfastly supported the program for more than a decade. U.S. support stems from a desire to protect the United States and the world from a nuclear catastrophe. Many influential political leaders believe that the United States is an especially likely target of catastrophic terrorism, thus creating concern about the security of weapon-usable material in Russia. However, it is hard to convince Russian authorities that they should use their limited resources to help protect the United States if they do not perceive benefits for Russia. A much better approach is to pose the threat in broad global terms, arguing with good justification that a nuclear explosion anywhere would have political, economic, and health repercussions that would adversely affect all countries. It should also be emphasized that the technological capabilities of terrorist groups, including those in Russia, are advancing with each passing year. The threat will only increase with time.

CHAMPIONS AT THE HIGHEST LEVELS

Leaders at the highest levels—the Russian president, the prime minster, and leading Duma members—should be informed of Western views of the vulnerabilities of Russian facilities. During international meetings they should be en-

couraged to articulate the importance of modern MPC&A systems wherever weapon-usable material is located. At the implementing level, Rosatom, Rostekhnadzor, the security services, and other responsible bodies should be encouraged to consider MPC&A systems of high priority and reflect this priority in their policy and budget decisions. Also, the Russian Security Council and the Ministry of Foreign Affairs should continue to emphasize the international significance of greater Russian attentiveness to enhanced MPC&A systems.

To these ends, committed counterpart organizations within the U.S. government should use their many channels of interactions to convey the importance of modern MPC&A systems to these and other important Russian individuals and organizations. Further, the U.S. president and his advisors should repeatedly stress the significance of protecting weapon-usable material in their meetings with Russian counterparts; DOE and other departments should reinforce this message at the next level of interactions.

The U.S. government is not the only government interested in the security of Russia's weapon-usable material. Indeed, members of the G-8 have expressed both interest and concern on several occasions, and President Vladimir Putin has concurred with the importance of nuclear security in Russia and throughout the world. The topic of MPC&A should remain on the G-8 agenda for the indefinite future.

Of special importance is the potential role of the U.S. Nuclear Regulatory Commission (NRC), which has been very effective in the United States as a regulator and an advocate for modern MPC&A systems. The NRC could share procedures, training and regulatory expertise, and enforcement approaches with Russian counterparts. Since the NRC is restricted in the use of its own funds for international activities, DOE should provide increased financial support for the NRC to work closely with Rostekhnadzor in promoting increased security over weapon-usable material. DOE should be more receptive to ideas and insights offered by experts from the NRC regarding regulation and enforcement. Also, DOE should support the efforts of nongovernmental organizations in both countries to continually emphasize MPC&A.

OTHER STEPS TO DEVELOP CHAMPIONS FOR INDIGENIZATION

Based on many discussions in Russia, the committee believes that several additional steps would be helpful in stimulating greater interest in MPC&A throughout the Russian government and the general public.

DOE should continually share persuasive documentation on the risks associated with nuclear proliferation and high-consequence nuclear terrorism with key Russian policy officials. At the same time, DOE should not allow other DOE-funded programs in Russia (for example, those on radiological terrorism and on improving nuclear safety in future reactor designs such as inherently safe reactors) to supplant MPC&A as the top priority within the broader U.S.-Russian nuclear security relationship.

DOE should continue to work with Rosatom to develop a common sustainability strategy, modifying the concept to embrace indigenization. Russian officials and specialists should be encouraged to develop their own concept of indigenization as a basis for reaching agreement on a common approach. Unless Rosatom is fully committed to indigenization, U.S. efforts will have a limited effect. Thus, as a first step, it is important that U.S. efforts be oriented toward supporting compliance with Russian legal obligations as a means of reducing the likelihood of theft, diversion, or misuse of material in the long term. Also, as previously noted, DOE and Rosatom should subject a draft of the strategy to external review by recognized experts in order to obtain independent perspectives.

DOE and Rosatom should ensure that each site where cooperative MPC&A projects are located has a jointly developed indigenization plan. DOE and Rosatom should provide guidance for preparing such plans, recognizing that indigenization must be tailored to each individual facility. DOE and Rosatom need clearly understood and peer-reviewed metrics for measuring progress toward achieving the goals of these plans, using a methodology that is developed and embraced by Russian specialists. Progress should be measured by an appropriate Russian review body at least annually; the results of this review could then be shared with DOE. Since the cooperative program is only part of Russia's MPC&A upgrade activities, Russian specialists should also be encouraged to share their own experiences among themselves.

DOE should clarify the significance and function of MPC&A commissioning ceremonies held at Russian facilities for interested U.S. and Russian officials, specialists, and the general public. Rather than being considered the completion of the most important phase of MPC&A cooperation, these ceremonies should represent the beginning of the equally important phase of indigenization. For example, the transfer of responsibility for MPC&A equipment is a critical component of indigenizing the overall MPC&A system at the national and facility level. A limited number of U.S. specialists should continue to periodically visit commissioned facilities for several years after the ceremony to review the state of MPC&A systems and ascertain how the U.S. government might further encourage the indigenization process.

DOE should provide Rosatom and other Russian counterparts with information concerning nonproliferation and the prevention of catastrophic terrorism that would be of interest to the Russian public and encourage its wide distribution. Indeed, public outreach in Russia should become an increasingly important aspect of the cooperative program.

The foregoing actions, if implemented, would raise the awareness of the importance of effective MPC&A systems in Russia. They would greatly assist in encouraging Russian specialists to become MPC&A champions in both the short term and long term.

3

Financial Support of MPC&A Activities

CURRENT FUNDING OF MPC&A ENHANCEMENTS

As indicated in Chapter 1, during the past twelve years the U.S. Department of Energy (DOE) has received over $1.5 billion in Congressional appropriations for participation in the cooperative nuclear materials protection, control, and accounting (MPC&A) program with Russia (see Appendix H for information on recent appropriations). Limited financial support has also been provided by several other Western governments. These external funds for upgrading MPC&A systems have supplemented Russian investments in maintaining, operating, and occasionally upgrading existing systems.

There are no publicly available estimates of the aggregated MPC&A budgets of Russian facilities or even the budgets of individual facilities. According to Rosatom officials, the agency provides very limited earmarked funding for MPC&A activities at selected Rosatom facilities, thereby only marginally supplementing funds available from regularly allocated facility budgets. These officials stressed that such special allocations are very small and unlikely to increase in size. Also, as noted in Chapter 1, the Russian Academy of Sciences provides a small MPC&A supplement to the core budget of its Gatchina facility, which has a research reactor and is constructing a second reactor.

The amount of additional funding that will be required from abroad to upgrade protection of weapon-usable material across Russia depends on Russia's readiness to assume responsibility for the use of modern methods to protect its own material and to share the financial burden of doing so. This report assumes that there will be a significant shortfall in the Russian contribution for some

years. In addition to initial upgrades, the cost of adequate maintenance and operation of MPC&A systems, which presumably will be the responsibility of Russian facility managers in the future, is significant.[1]

It is tempting to argue that U.S. financial support for the cooperative program should be terminated, or at least significantly reduced, in the immediate future. The Russian economy is slowly recovering, thereby putting the Russian government in a better position to assume more of the burden for financing MPC&A systems. Unfortunately, financial realities within Russia will undoubtedly inhibit such financial allocations in the near term even if prices for Russian oil continue their upward climb.

There are many competing priorities for new resources available to the Russian government. While the World Bank reports a stabilizing economy and optimistic economic growth prospects, nineteen percent of the Russian population is classified as living below the poverty line.[2] Thus, significant increases in budget allocations for modernizing MPC&A systems on a broad scale seem unlikely for the next few years. The competing demands of pensions, better health care, and adequate housing, for example, are simply too strong. Even if new resources are earmarked for nuclear security in general, facility managers will have difficulty effectively acquiring more resources for MPC&A upgrades to protect Russian materials given the widespread perception in Russia that facility vulnerability is not a serious problem. In time, however, a coalition of MPC&A champions should be able to argue for a larger percentage of government resources for MPC&A. But at present, instead of spending more on MPC&A, the Russian government's emphasis is on increasing salaries at nuclear facilities, where average paychecks are still small.

As a result, the United States needs to both continue investing in MPC&A and insist on greater Russian investment. A sharp U.S. reduction in funding would surely slow the pace of enhancing security for weapon-usable material. At

[1]DOE informed the committee that it had projections of costs through 2013, when current U.S. law requires termination of all U.S. funding (see Appendix D.2), but DOE considers cost estimates beyond 2009 as privileged. Official DOE estimates provided to the committee by DOE of anticipated expenditures through 2009 are included in Appendix H. After considering DOE estimates and taking into account the amount of work that remains, the committee believes that DOE will need at least $500 million through 2009 and $300 million more for upgrades thereafter if it continues operating in its current manner. Further, in May 2005, a senior Rosatom official informed the committee that Rosatom will need nearly $500 million of external funding from 2006 through 2012 to finish upgrades at Rosatom facilities and to fully develop the infrastructure (training, maintenance, and accountancy facilities, etc.) for a sustainable program. This estimate does not include the costs of upgrading naval and other non-Rosatom facilities.

[2]The World Bank's *Russia Economic Report* of March 2005 indicates that the GDP growth rate for 2004 was 7.1 percent. The percentage of Russian citizens living below the poverty line in 2004 was 19 percent, however. See http://194.84.38.65/mdb/upload/RER10_eng.pdf.

present, the Russian government has neither the political will nor the readily available resources to accept the full burden of indigenization. But it certainly is in a position to move toward that objective.

FINANCING FOR THE LONG TERM

In order to encourage Russian ownership of the process for upgrading and maintaining MPC&A systems, a new funding mechanism that calls for greater Russian leadership and for a greater Russian role in decision-making is needed.

Therefore, the committee believes that an international MPC&A Indigenization Fund should be established within the framework of the G-8 Global Partnership to provide financial support for MPC&A improvement projects proposed by Russian facilities that have demonstrated their commitment to strong MPC&A systems. While the details of such a fund, including the appropriate funding level, must be determined through analyses of technical and financial requirements and through negotiations involving all interested parties, a description of one model that might serve as the basis for initial discussions follows.

The Fund would have an initial investment of $500 million to dispense to Russian institutes and other facilities over a period of ten years, with the average annual disbursement to these institutions being $50 million. This estimate accounts for the extensive size of the nuclear complex, the condition of facilities that must sustain security enhancements over the long term, and the need to develop a strong cadre of technical specialists. DOE projections of future expenditures for MPC&A improvements indicate that $500 million is an appropriate initial point of departure for international negotiations.[3]

As a point of comparison, the International Science and Technology Center (ISTC) in Moscow dispensed more than $600 million during its first ten years. This Center has been judged to be very successful by a number of governments that continue to contribute substantial resources for its operations. The Center does not support any major construction activities, although it supports projects in a wide variety of fields, including the nuclear sector.

The interest that is earned on the funds of the Indigenization Fund, until they are dispensed, would be used to cover the costs of the secretariat of the Fund and the cost of projects that could become important focal points for Russian government coordination, such as training, information dissemination, and scientific conferences.

Contributions to the Fund might include the following: $200 million from the United States; $100 million from Russia (in cash, not in kind), and; $200 million from other G-8 partners. Ideally, the money would be committed as soon as the Fund is established, when political enthusiasm for such an international

[3]See footnote 1 of this chapter.

effort would probably be at its peak. Also, if contributions were spaced over a number of years, the interest available to the Fund would be reduced accordingly.

The Russian contribution clearly would signal Russian readiness to begin to take full ownership of upgraded systems. This contribution would be used in particular, to support activities at sensitive facilities where Russian specialists assigned to the Fund would have responsibility for monitoring and auditing activities pursuant to guidelines prepared by the Fund. The procedures for ensuring that Russian funds were spent as intended would be worked out in detail. The Russian government's financial commitment would be sufficiently large, and the lifetime of the fund sufficiently short, to ensure that there would be a clear shift of responsibility for funding from foreign to Russian sources.

The Fund would be managed by a new intergovernmental entity, taking into account the experiences of the ISTC, which is led by an international team and staffed primarily by Russian specialists. Representatives of those governments providing the financial resources would serve on the governing board of the Fund. Other intergovernmental mechanisms that have effectively provided international funds to sensitive nuclear facilities in Russia would also provide useful background. While the Fund would have unique characteristics, experiences of other organizations in areas such as taxation, access to sensitive facilities, and auditing procedures would be helpful.

The fund would provide financial resources on a competitive basis in response to Russian proposals for MPC&A improvement projects. Each government that provides funds would have the right to select the projects it would support with its contribution, and it would have the right to veto a proposed project to be funded by others for technical reasons.

The size of the grants would vary, perhaps reaching several million dollars for multi-year projects involving significant construction or consolidation activities. Smaller projects would address replacement parts, enhanced accounting software, and other aspects of MPC&A systems. The Fund would not support operational activities such as guard services and routine maintenance. Guidelines would be proposed to help distinguish routine from enhancement activities. Specialists from laboratories of DOE, Russia, and the other G-8 partners would assist in reviewing the strength of the proposals and in monitoring the implementation of approved projects.

Since the Russian government would approve each project, Russian representatives would be in a good position to ensure consistency among the proposals funded by different governments and with Russian regulations. Further, the Fund could establish guidelines to assist in ensuring consistency. This Russian responsibility would be an important step toward indigenization of MPC&A systems.

As noted, the Russian contribution would be used primarily to support particularly sensitive projects. These projects would be considered along with all other projects except that they would be described in general terms to protect

sensitive information. The monitoring and auditing results of funded projects would be presented in nonsensitive terms.

In short, the Fund would enable Russian facilities that are on sound paths toward indigenization to obtain funding to complete that process and maintain and improve their technical capabilities over the long run. Also, the management of the Fund would engage senior Russian officials from several ministries to promote indigenization. Their direct decision-making responsibilities for fund-supported projects should contribute to a broader awareness within the Russian government of the importance of enhanced MPC&A systems. The projects would respond to Russian regulatory requirements while providing Western partners on the governing board an opportunity to ensure that the projects reflect international perspectives on sound MPC&A systems.

While the establishment of a new international structure and its multinational decision-making processes could delay implementation of some projects, speed in the indigenization process is not as critical as that of the initial installation of upgrades. Should there be an urgent project, DOE has the option of using its own resources to address the problem if other resources cannot be mobilized quickly. Serious discussions among the governments participating in the Fund will serve to raise international sensitivity regarding the importance of MPC&A; this benefit will outweigh the delays that may be encountered in the establishment of the Fund.

Several years may be required to establish the Fund, and upgrading activities should continue apace during this period. As an immediate step, international specialists should carry out the detailed analyses required to help frame the discussion that would lead to the Fund's establishment. The United States will inevitably lose some control of the MPC&A program in Russia. However, this will actually serve the overall objective of indigenization: to move from a United States-directed effort to a Russian-directed effort. The United States will still have the right to veto proposals and can fund those projects it considers of highest priority.

Prior to proposing creation of an indigenization fund, the committee also considered the following alternatives to help ensure future funding of MPC&A enhancements beyond the resources that are currently available from Russian budgets:

- *Continue DOE funding of the effort*. This approach is expensive for the United States and perpetuates a U.S.-directed model, whereas the Fund strongly encourages other countries to share the cost burden while moving toward indigenization.
- *Require Russia to fully fund MPC&A.* This is ultimately desirable, but is not feasible at the present time. The Fund is a meaningful step in this direction.
- *Trade Russian debt for Russian support of MPC&A, use funds from the profits of the proposed international repository for storage of spent nuclear fuel*

in Siberia, or earmark funds earned in the U.S.-sponsored HEU to LEU blend-down enrichment program for MPC&A. These options have been debated for years with no practical outcome. They all have a common problem: money must be taken away from existing Russian claimants. The proposed Fund is based on newly-allocated funds and should therefore avoid that drawback.

In summary, the Indigenization Fund is the most desirable alternative for the following reasons:

- By placing the program in the context of the G-8 nuclear security initiatives, which are backed by significant financial commitments from most if not all of the member countries and have garnered considerable political support from Russia, the highest levels of the Russian government would likely give higher priority to modern MPC&A systems than before.
- The approach of funding projects proposed by Russian institutions and subject to the approval of the U.S. and other governments, would be an important step toward Russian ownership of the program.
- The ISTC experience has demonstrated that multilateral programs with substantial budgets can be established and effectively implemented at sensitive facilities in Russia, while maintaining appropriate security and confidentiality measures.
- DOE would retain the option of directly financing proposed projects that might be delayed within the fund.

OTHER FINANCING MECHANISMS FOR RAPIDLY IMPROVING SECURITY

In addition to this new initiative, Congressionally appropriated funds should continue to support current DOE efforts, although these efforts should increasingly incorporate indigenization principles and approaches. As the Fund is established and begins operation, the committee believes that the DOE budget should decline accordingly, although the timing and rate of decline will depend on the schedule and commitments for the Fund. As all weapon-usable material at specific facilities comes under an acceptable level of security and as these facilities move along realistic and timely schedules toward complete indigenization, they would become eligible to apply for support from the Fund. In short, as DOE support ends, they would not face a financial void. At the same time, several steps can be taken to increase resources for MPC&A enhancement even before the Fund is fully functioning.

The Russian Federal Target Program that encompasses Russia's own MPC&A program deserves greater support from the Russian government (see Appendix J). Indeed, President Putin acknowledged in 2003 that the program was underfunded. DOE should therefore explore the feasibility of greater cost-sharing

with Russia's MPC&A program. One area of joint cost-sharing may be the ongoing development of the national accounting system. This may encourage the establishment of a complete and detailed baseline inventory of materials.

DOE should consider how its other cooperative programs in Russia, such as the program to improve the protection of ionizing radiation sources, could complement the MPC&A program at specific facilities. As previously noted, however, the paramount importance of the MPC&A program should not be compromised.

DOE should encourage Rosatom to offer one or more Russian facilities as models for efforts coordinated by the International Atomic Energy Agency (IAEA) to upgrade MPC&A systems world wide. (The model sites selected should not be among the most highly sensitive facilities.) The transition from Western cooperative programs to Russian programs should be an important aspect in the development of the models. The U.S. government should support allocation of IAEA training funds to the selected model facilities. While these funds would be relatively small, IAEA support would be prestigious for the facilities and might lead to additional income opportunities.

DOE should encourage Rosatom and Russian enterprises and institutes to begin the transition from DOE-funded training programs for MPC&A specialists to self-sustaining programs. Russian enterprises and institutes should increasingly be expected to provide funds to support the transportation, lodging, and per diem costs of their own specialists attending courses at training centers, such as the center in Obninsk. Also, Rosatom should begin to cover the costs of operating these training facilities. While some institutes and enterprises are developing their own on-site programs for training MPC&A specialists, the demand for training at specialized centers will probably continue for the indefinite future.

DOE should improve its understanding of the current and potential sources of Russian funding for MPC&A. DOE should encourage transparency in MPC&A allocations at both the federal level and at the facility level to the extent consistent with security considerations. Familiarizing appropriate Russian legislators, officials, and specialists with budgetary approaches used by the U.S. Congress, the U.S. executive branch, and individual U.S. facilities should be helpful in this regard.

In summary, a new international MPC&A Indigenization Fund should be a cornerstone of indigenization efforts, while providing an important financial base to ensure that significant aspects of modern MPC&A systems are maintained and improved in the long term across Russia. If other approaches such as those identified above are also adopted, the overall financial support required for adequate MPC&A systems should be sufficient to fully secure Russia's weapon-usable material now and in the future.

4

Improved Approaches to Facilitate Indigenization

Finishing the current task of upgrading materials protection, control, and accounting systems in ways that facilitate indigenization is critical. As noted in earlier chapters, approximately 50 Russian entities currently participate in the cooperative materials protection, control and accounting (MPC&A) program. Some participating facilities are among the most sensitive in the Russian nuclear weapons research and development complex, and others are at sensitive Russian naval installations. A number of Russian facilities are located at distant locations where once few foreign visitors ventured and where Russian specialists had limited exposure to developments outside their own country. There are also facilities, including universities and civilian research centers, in large urban areas, where nuclear safety and security are of critical importance to the nearby residents of the cities.

Based on the committee's observations and discussions with Russian and United States experts, the improvements in MPC&A systems at sites where the U.S. Department of Energy (DOE) has been engaged have contributed greatly to the security of Russian weapon-usable material. Still, the results of the cooperative program have been inconsistent. The many successes have been offset by repeated extensions of the schedule for protecting all material, although recently the U.S. target date for completion has been changed from 2011 to 2008. Some upgrades have greatly strengthened security procedures, but others have not succeeded as planned. A few have even required replacements. The security at some facilities has dramatically increased, but at others security remains inadequate. Training programs have been very important, but improved material control and accounting have continually lagged years behind other aspects of the program.

Indeed, some facilities still have not fully conducted measured physical inventories of existing material. Finally, few facilities can report progress in disposing of excess weapon-usable material for which there is no current or future need. Finally, there is not a single reported example of a facility outside the navy program where dormant weapon-usable material has been transferred to a more secure location.

IMPROVED APPROACHES

Access to Facilities

In the past, difficulties experienced by United States specialists in gaining access to sensitive Russian facilities within the Rosatom complex were frequently cited by DOE as a major impediment to MPC&A progress. Such access has been required for U.S. specialists to participate in the design of systems, monitor progress, and audit expenditures. Issues over access to Rosatom sites in both closed and open locations have clearly delayed the program. In contrast, there have been far fewer problems at facilities outside the Rosatom complex. In recent years, Russian access to U.S. laboratories for familiarization with U.S. approaches has been difficult. While the need for such familiarization visits has declined in recent years, this lack of reciprocity has not been lost on Russian officials. Nevertheless, as indicated in Box 4.1, DOE believes significant progress has been made in resolving access issues. The committee is not in a position to endorse this statement but considers it to be important and worth noting.

As discussed in previous chapters, DOE cooperation with the Russian navy to secure fresh nuclear fuel rods fabricated for use in submarines has been highly

BOX 4.1
Access to Sensitive Facilities

Significant progress has been made in resolving the issue of access. DOE and Rosatom have established an acceleration working group that has formulated procedures to allow limited access to some of the more sensitive Rosatom facilities. These procedures have been successfully employed at a pilot facility, which led to an agreement to use the strategy at two additional facilities. Based on the success of this approach, DOE remains confident that it will have sufficient access to sensitive facilities to meet DOE's commitment to complete the installation of rapid and comprehensive upgrades at all facilities in the joint MPC&A program by the end of 2008.

SOURCE: Official statement by DOE conveyed to the committee in January 2005.

successful, a remarkable achievement given military sensitivities. While there is a difference in discipline between military and civilian organizations, some of the approaches underlying the success of the program at naval sites nevertheless should be transferable to activities at sensitive sites under the control of civilian entities. For example, limiting the number of U.S. participants involved in the program to a few specialists who have remained with the program over many years has increased understanding and respect on both sides, which is essential for productive cooperation. Also, the important role of Russian specialists from the Kurchatov Institute, who serve as expert facilitators and intermediaries, thereby reducing the requirements for repetitive U.S. visits to sensitive sites, was an important innovation that might be replicated in other aspects of the overall program. Of even greater importance has been the steadfast commitment of the Russian Navy leadership to the program. While DOE has little influence over selection of Russian program leaders, the exemplary role of the navy leadership deserves frequent mention in U.S.-Russian intergovernmental discussions.

There are a few Russian facilities where significant amounts of weapon-usable material are believed to be housed that are not currently included in the cooperative program. DOE should work more intensively with Rosatom to identify such facilities and to include them in cooperative activities. For example, the Research Institute for Nuclear Technologies (NITI) in Sosnovy Bor, where material is probably located, has remained outside the program. The Krasnoye Sormovo Shipyard in Nizhny Novgorod and the Amursky Zavod Shipyard in Khaborovsk Territory also may have weapon-usable material.

Since Russian activities at these sites were largely unknown to the committee, they are not addressed in this report. Nevertheless, if weapon-usable material is located at additional sites, it deserves priority consideration by DOE. If cooperation with these facilities is initiated, the goal of indigenization should be incorporated into every aspect of the program from the very beginning.

At some facilities, DOE will probably have to be more flexible than in the past in: (1) allowing Russian specialists to play a more decisive role during the selection and design of upgrades; (2) modifying contractual requirements and procedures that may be considered too intrusive by Russian organizations; and (3) finding alternatives to access at facilities that for legal reasons deny entry to visitors from outside of Russia. For example, Russian managers at such sensitive facilities may design MPC&A upgrades and, after editing the designs to remove classified details, have the designs reviewed by U.S. specialists. Revised versions of the Russian designs that are satisfactory to both sides could then be used, photographed, and videotaped by Russian specialists with certifications signed by institute directors. Finally, the process, expenditures, and results of upgrades including non-sensitive information on operating experience could be discussed off-site by Russian and U.S. specialists. Such an approach using technical means for verification of MPC&A upgrade activities is not ideal, but it is better than a continued stalemate concerning important facilities.

Streamlining the Contract Process

The DOE-Rosatom cooperative MPC&A program has been well funded.[1] At the same time, the leaders of every Russian facility that the committee visited[2] contended that important projects were being delayed due to a reluctance by DOE to provide funding. DOE officials contended that the dormant project proposals for upgrades did not coincide with DOE priorities, even if Russian law required such upgrades and even if the upgrades would contribute to the security of weapon-usable material.

Much of the Russian concern regarding proposed projects, has related to improving security along the perimeters of facilities, as mentioned in Chapter 1. Such projects are often expensive, therefore if financial resources were limited, DOE's reluctance to fund perimeter projects would be understandable, since they are often considered by DOE experts as less effective in protecting weapon-usable material than security enhancements closer to the material. Nevertheless, the main constraints in such cases have frequently been policy disagreements and DOE's insistence that its priorities must prevail over jointly agreed-upon priorities. However, as noted in Chapter 1, DOE is now reconsidering its policy concerning perimeter security, which may allow the initiation of new projects proposed by Russian experts.

DOE's contracting procedures are a significant cause of delays in the program. Each task order, however small, requires approval at several levels in the United States and by a special committee of the Russian government that grants tax exemptions. This process, particularly on the Russian side, may take from three to six months or more to complete. Task-by-task negotiations of hundreds of small tasks each year at Russian sites (from $5,000 to $100,000 in cost) delay activities as the contractual documents await signature in each country. Also, each task order requires U.S. visitors to verify expenditures. As an example of the potential for bottlenecks in the program, more than 420 separate tasks, valued at a total of $15.3 million, had been negotiated by DOE with the Institute for Physics and Power Engineering in Obninsk as of May 2005.[3] Despite delays in the United States as well as Russia, DOE considers the problem now to be one of Russian bureaucracy (see Box 4.2).

Alternative contracting procedures that compress timelines are necessary and have important implications for indigenization. Larger tasks, umbrella tasks, or both seem to be an obvious approach to be considered. Moving toward larger

[1]Statement of Paul M. Longsworth, deputy administrator for defense nuclear nonproliferation, National Nuclear Security Administration, U.S. Department of Energy, before the Senate Armed Services Committee, U.S. Senate, March 10, 2004.

[2]See Appendix F for a list of sites visited by the committee.

[3]Information provided by Rosatom to the committee, May 2005.

BOX 4.2
MPC&A Contracting Delays

At one site of the Rosatom weapons complex, the U.S. project team was told by its principal Russian contact that a contract that had been awaiting approval for many months had finally been signed and that it took fifty separate signatures, both within and outside the site, to have it approved. Also, to receive the Russian tax exemption as agreed, the program needs a tax exemption certificate for each transfer of funds or delivery of equipment. After receiving the task order, Rosatom submits a request for a tax exemption certificate to a special committee of the Russian government for approval. The process may take three to six months. However, the process to request an exemption certificate can begin shortly after a contract or task order is signed and does not generally cause delays in executing the contract.

SOURCE: Official communication to the committee by DOE, January 2005.

task orders reduces U.S. micromanagement practices, which are often reflected in small task orders and do not facilitate progress toward indigenization.

Another problem attributable at least in part to the emphasis on small task orders has been a decline in the MPC&A experience of the DOE teams traveling to Russia. Many of the most experienced U.S. MPC&A specialists have grown tired of repetitive trips to Russia to address the details of small task orders. According to managers at one Russian institute, eleven visits by U.S. specialists were required to complete the details of one task order of less than $100,000. While the committee could not verify this statement, there clearly is frustration among Russian experts over the never-ending negotiation and renegotiation of even the smallest contract details. Russian counterparts are well aware of the many changes in the composition of U.S. teams, and at times they refer to DOE team members as administrative personnel rather than technical specialists. Also, they sarcastically talk about nuclear tourism on the U.S. side. DOE could further improve its use of advanced communications, such as video conferences, to reduce travel demands. Additionally, there may be opportunities for Russian experts to incorporate more effective business practices into their regular contracting negotiations with DOE as a means of reducing costs and increasing the efficiency of cooperative MPC&A efforts.

Practical Steps Toward Indigenization

The committee considered a large number of possible modifications to the current program that would contribute to more rapid progress in completing MPC&A upgrades at Russian facilities and that would enhance the prospects for

meaningful and lasting indigenization. Some of the relevant conclusions are set forth in previous chapters.

Umbrella task orders of up to $1 million or even more should become more frequent, with subtasks detailed as necessary; funding should be transferred upon completion of each subtask as is currently done. Indeed there have been efforts by DOE to use this approach. Greater responsibility should be placed on the Russian organization concerned to prepare the detailed plan for the overall task order and subtasks. DOE specialists should review and modify the proposed approaches when necessary. Verification of fiscal accountability should therefore be possible through less frequent visits than are required to verify a number of small contracts.

DOE and Rosatom should give priority to improving accounting systems at the facility level and should more actively support the development and operation of the national accounting system. Initial physical inventories of material at the institute level—based on measured values—are of particular importance. This will improve the accuracy of data incorporated into the internal accounting systems, and subsequently, the data transmitted to the national system. In some institutes, two-track systems may be necessary at the outset, involving: (1) rapid but crude inventories of all materials; and (2) more detailed inventories of the materials that pose the greatest risks. While it is important that accounting systems exist, it is equally important that there be timely and accurate data transmitted to the national system. A strong regulatory basis is essential to ensuring the integrity of the data and the system as a whole.

DOE, in cooperation with Rosatom and other appropriate Russian governmental agencies such as Rostekhnadzor, should continue to support the development and adoption of necessary laws, decrees, and regulations that will expand and clarify the legal infrastructure for MPC&A. However, working with Russian counterparts, DOE should give greater attention to establishing priorities among the many dozens of documents in preparation and fostering rapid adoption of sound modern approaches. In addition, it is important that DOE and its Russian partners work to ensure that those regulations are enforced. These documents address, for example, regulatory requirements, inspection infrastructure, information systems, measurement procedures, instrumentation requirements, and instrument calibration. Important criteria in prioritizing the documents should include: new documents of priority to the Russian government; the anticipated effect of the documents on the near-term protection of materials against both insider and external threats; and, the long-term indigenization significance of the documents.

DOE and Rosatom should jointly review the many interactions among Russian organizations involved in protecting material at the facility level to identify areas in which coordination can be improved. For example, procedures concerning the transportation of materials between sites, overlapping responsibilities of Rosatom and Rostekhnadzor at Rosatom facilities, and interactions between guard

forces and facility management are areas that could result in security vulnerabilities if neglected.

Responsibility for guard forces at some facilities has been transferred from the Ministry of Internal Affairs to Rosatom. DOE should continue to work with Rosatom to help ensure an orderly transition of guard forces to the new Rosatom enterprise system, keeping in mind that Russia has extensive experience in organizing guard forces. While some facilities will continue to rely on the Ministry of Internal Affairs and other guards will remain at their current positions, there will be a number of new guards. As more guards enter the system, screening and training programs will be particularly important.

DOE should continue its emphasis on the development of local capabilities, particularly private sector capabilities, to design, produce, and service system components. In many cases, system components that are used in cooperative projects should be manufactured in Russia. When only foreign equipment is available, preference should usually be given to equipment that can be easily serviced by Russian firms. DOE should recognize the important role of the equipment certification process as part of the overall regulatory system in Russia. At the same time, that certification process should support the overall MPC&A mission.

MPC&A upgrades should emphasize the use of sturdy equipment that is relatively inexpensive to operate and maintain, minimizes electric power consumption, and has proven reliable in the Russian environment. Reducing the costs associated with maintenance is an important aspect of indigenization.

DOE should rely on the Russian facilities to serve as prime contractors for Russian subcontractors that provide and install upgrade equipment at facilities. Currently, some DOE contracts are signed directly with Russian equipment providers to install upgrades at the facilities. This approach significantly reduces the capability of the facilities to control the equipment installation and may result in equipment that does not conform to technical and operating requirements of the facility. Even though the facilities formally endorse the plans for installing equipment, unanticipated problems often arise and occasionally cause managers to resist, rather than embrace, the installed upgrades. While placing subcontract management responsibility on the Russian facility may in some cases delay installation, in the long term it will contribute to indigenization by allowing the facilities to have direct control over the equipment providers during and after installation and by requiring the facilities to develop the capability to deal with subcontractors.

DOE should ensure that ownership titles of equipment provided to Russian facilities are legally transferred to the facilities, with due attention to avoidance of value-added and other taxes from which U.S. assistance is exempt. There has been some uncertainty among facility managers about this issue.

DOE should carefully review the ratio of its expenditures between funds managed and expended directly by DOE laboratories and funds transferred to and

managed by Russian facilities. The percentage provided to Russian facilities should increase as rapidly as possible to reflect the importance of indigenization. This approach could allow savings on the U.S. side by reducing the number of U.S. visits required to manage activities that Russian experts could supervise.

Some of the foregoing steps have been taken by DOE on a modest scale. Indeed, since this study was initiated in 2003, the DOE management team has demonstrated much greater sensitivity to the importance of indigenization and has reflected this sensitivity in a number of program activities. Still, a more concerted effort in these areas would expedite the upgrade process and also foster indigenization.

Epilogue

In the long term, meticulous control and protection of weapon-usable material in Russia is critical for world security. Over the past decade, the Russian and U.S. governments have engaged in unprecedented cooperation in this highly sensitive area and have supported important steps to help secure this material. Now, as the technological sophistication of terrorist groups operating in Russia and elsewhere increases, it is more important than ever that the United States and Russia achieve their goals for the security of weapon-usable material and transfer full responsibility to Russia for protecting its own material.

Ensuring the security of weapon-usable material is a complex process. It requires knowledgeable and dedicated personnel at the national and facility levels; effective materials protection, control, and accounting (MPC&A) procedures that are routinely enforced; performance testing programs; incentives to report problems and take corrective actions; and programs to emphasize and reinforce best practices.

While there has been considerable progress in these areas as a result of the U.S.-Russian cooperative program, a number of challenges remain. Among U.S. and Russian experts, there remain different perceptions of the threat to Russian nuclear facilities posed by theft of material. Further, the Russian legal, regulatory, technology, and training infrastructures for supporting modern MPC&A systems are not fully developed. And there is hesitation both in Moscow and Washington to reorient cooperative endeavors of the past decade away from a technical assistance model toward genuine partnership.

These challenges are slowly being addressed. The committee believes that the recommendations set forth in this report will help preserve the successful approaches of the past decade and will assist in the adoption of improved approaches to achieve a sound, Russian-directed MPC&A program.

The MPC&A program in Russia must succeed. The security of Russia's weapon-usable material is an imperative for Russia, for the United States, and for the world.

Appendixes

A
Agreement Between the Government of the United States of America and the Government of the Russian Federation Regarding Cooperation in the Area of Nuclear Material Physical Protection, Control, and Accounting

The Government of the United States of America and the Government of the Russian Federation, hereinafter referred to as the Parties,

ACKNOWLEDGING the importance of strengthening the nuclear weapons nonproliferation regime through the improvement of systems of physical protection, control and accounting of nuclear materials (hereinafter referred to as MPC&A);

TAKING INTO ACCOUNT the considerable growth in cooperation in MPC&A between the Parties, including the increase in the technical exchanges between the relevant scientific centers of the United States of America and the Russian Federation;

AFFIRMING their commitment to continue successful cooperation in MPC&A;

NOTING the Convention on Physical Protection of Nuclear Materials of March 3, 1980;

TAKING INTO ACCOUNT the recommendations of the IAEA in the area of physical protection of nuclear materials;

ATTACHING important significance to strengthening MPC&A cooperation between the Parties in view of implementation of current and future agreements in the nuclear arms reduction area;

BELIEVING that the increase of the efficiency of MPC&A is a contribution to the efforts to prevent illicit trafficking in nuclear materials;

HAVE AGREED AS FOLLOWS:

ARTICLE I

1. This Agreement and all activities undertaken in accordance with this Agreement shall be subject to and governed by the provisions of the Agreement Between the United States of America and the Russian Federation Concerning the Safe and Secure Transportation, Storage and Destruction of Weapons and the Prevention of Weapons Proliferation of June 17, 1992, as extended and amended by the Protocol signed on June 15 and 16, 1999 (hereinafter referred to as the 1992 Agreement).
2. The Parties may cooperate in the following areas:
a. The further development of existing national programs of MPC&A;
b. The improvement of systems of MPC&A, including those related to the transportation of nuclear materials;
c. Furnishing modern systems of MPC&A as well as appropriate equipment and instruments to facilities of the Russian Federation where direct-use nuclear materials are located;
d. Prevention of illicit trafficking in nuclear materials; and
e. Such other areas of cooperation within the scope of this Agreement, as the Parties may agree upon in writing.

ARTICLE II

The Parties may cooperate on upgrading MPC&A, including of highly enriched uranium and separated plutonium, at mutually agreed facilities located on the territory of the Russian Federation.

ARTICLE III

1. Notwithstanding the provisions of Article III of the 1992 Agreement:
a. The Executive Agent for the Russian Party for implementation of this Agreement shall be the Ministry of the Russian Federation for Atomic Energy.
b. The Executive Agent for the U.S. Party for implementation of this Agreement shall be the United States Department of Energy.
c. Each Party shall have the right to change its Executive Agent, or designate additional Executive Agents. Such decisions shall enter into force 30 days after written notice to the other Party.
2. The Executive Agents may involve other ministries or agencies, laboratories, facilities and organizations in the joint cooperation to implement this agreement.
3. The Parties shall establish a Joint Coordinating Committee (JCC). Each Party shall designate its members on the JCC. The Co-chairmen of the JCC shall be representatives of the Parties' Executive Agents. Meetings of the JCC shall be convened periodically upon agreement of the Co-Chairmen of the JCC but not less than once a year, alternately in the United States of America and in the

Russian Federation unless otherwise agreed. Decisions of the JCC shall be made on the basis of consensus. The responsibilities of the JCC shall include:
a. To develop Joint Action Plans, recommendations and appropriate implementing agreements and mechanisms to facilitate coordination and implementation of activities under this Agreement;
b. To review implementation of the provisions of this Agreement and to resolve issues that may arise in the course of its implementation;
c. To discuss and to draft, if necessary, recommendations to the Parties concerning amendments to this Agreement as well as proposals to the Parties for resolving disputes that are not resolved at the JCC level.

ARTICLE IV

1. To facilitate the effective fulfillment of work done under this Agreement, and in accordance with the legislation of the Russian Federation, the Russian Party shall take all necessary measures to permit access of representatives of the U.S. Party at those locations at the facilities where activities related to this Agreement are being conducted.
2. If access to such locations at the facilities referenced in, and for the purposes described in, Paragraph 1 of this Article is restricted by the legislation of the Russian Federation, the Executive Agents shall jointly develop alternative flexible, nonintrusive and mutually acceptable methods that do not require access by the representatives of the U.S. Party.

ARTICLE V

1. Under this Agreement, no United States classified information or Russian Federation state secret information shall be exchanged.
2. The information transmitted under this Agreement or developed as a result of its implementation and considered by the U.S. party as "sensitive" or by the Russian Party as "konfidentsialnaya" must be clearly designated and marked as such.
3. "Sensitive" or "konfidentsialnaya" information shall be handled in accordance with the laws of the state of the Party receiving the information, and this information shall not be disclosed and shall not be transmitted to a third party not participating in the implementation of this agreement without the written consent of the Party transmitting such information.
a. According to the laws and regulations of the Russian Federation, such information shall be treated as "limited-distribution official information." This information shall be protected in accordance with the laws of the Russian Federation.
b. According to the laws and regulations of the United States, such information shall be treated as "foreign government information," provided in confidence.

Such information shall be protected in accordance with the laws and regulations of the United States of America.
4. Information transmitted under this Agreement must be used solely in conformance with this Agreement.
5. The Parties shall minimize the number of persons having access to information which is designated "sensitive" or "konfidentsialnaya" information in accordance with Paragraph 2 of this Article.

ARTICLE VI

The Parties shall ensure the effective protection and allocation of rights to intellectual property transferred or created under this Agreement, as set forth in this Agreement and in the Annex, which is an integral part of this Agreement.

ARTICLE VII

1. The Russian Party shall ensure that the support or assistance provided in accordance with this Agreement is used solely for the purposes of effectively implementing MPC&A.
2. The U.S. Party and its representatives shall have the right to carry out quality assurance activities through access to those locations at the facilities where MPC&A activities are being conducted.
3. The Parties' Executive Agents shall develop appropriate arrangements for ensuring the effectiveness of all work performed within the framework of this Agreement.

ARTICLE VIII

1. Joint activities in accordance with this Agreement may be supported by funds and in-kind contributions of equipment, materials, and labor provided on a non-reimbursable basis by the U.S. Party in addition to the resources being appropriated by the Russian Party for the purposes of improvement of MPC&A in the Russian Federation, and resources received by the Russian Federation directly from other sources.
2. In all cases, the activities of the United States of America and the financial support it provides under this Agreement are subject to the availability of appropriated funds.
3. In all cases, the activities of the Russian Party and the financial support it provides under this Agreement are subject to the availability of appropriated funds.

ARTICLE IX

The U.S. Party and/or its designated representatives may purchase equipment, materials, or services in the Russian Federation for purposes of this Agreement.

ARTICLE X

1. This Agreement shall be applied provisionally from the date of signature, and shall enter into force upon entry into force of the Protocol signed on June 15 and 16, 1999. This Agreement shall remain in force so long as the 1992 Agreement remains in force.
2. This Agreement may be amended after the date of signature or extended by the written agreement of the Parties.
3. This Agreement may be terminated by either party 90 days after giving written notification to the other party of its intention to do so.

Done at MOSCOW, this 2nd day of October, 1999, in two copies, each in the English and Russian languages, both texts being equally authentic.

[Yevgeniy Adamov]
FOR THE
GOVERNMENT OF THE
RUSSIAN FEDERATION

[Bill Richardson]
FOR THE
GOVERNMENT OF THE
UNITED STATES OF AMERICA

B
Specific Recommendations from Two Previous National Research Council Reports Concerning Indigenization of MPC&A

PROLIFERATION CONCERNS: ASSESSING U.S. EFFORTS TO HELP CONTAIN NUCLEAR AND OTHER DANGEROUS MATERIALS AND TECHNOLOGIES IN THE FORMER SOVIET UNION, 1997[1]

Indigenize MPC&A Capabilities

- Continue to emphasize the importance of materials protection, control, and accounting (MPC&A) as a nonproliferation imperative at the highest political levels in the former Soviet Union.
- Prior to initiating MPC&A projects at specific facilities, obtain assurances at both the ministry and the institute levels that the upgrade programs will be sustained after improvements have been made. Financial incentives, such as support for related research activities, should be considered as a means of stimulating long-term commitments.
- Involve institute personnel to the fullest extent possible in determining how to use available funds for upgrades.

[1]National Research Council (NRC). 1997. *Proliferation Concerns: Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union,* National Academy Press, Washington, D.C.

- Give greater emphasis to near-term training of local specialists.
- Reward those institutes that are making good progress in upgrading MPC&A systems by giving them preference for participation in other U.S.-financed cooperative programs.
- Encourage the establishment of new income streams that can provide adequate financial support for MPC&A programs in the long term, such as earmarking for MPC&A programs a portion of the revenues from Russian sales of highly enriched uranium (HEU).
- Rely increasingly on domestically produced and locally available equipment for physical protection, detection, analysis, and related MPC&A tasks.

PROTECTING NUCLEAR WEAPONS MATERIALS IN RUSSIA, 1999[2]

Indigenize MPC&A Capabilities

- Increase the percentage of available U.S. funding that is directed to financing activities of Russian organizations, with a steadily declining percentage directed to supporting U.S. participants in the program.
- Expand efforts to utilize Russian equipment and services whenever possible and to encourage Russian enterprises and institutes to increase capabilities to provide high-quality equipment and associated warranties and services.
- Use Russian specialists from institutes with well-developed MPC&A capabilities to replace some U.S. members of teams at Russian institutions with less developed capabilities.
- Rely increasingly on Russian specialists to replace U.S. specialists in presenting MPC&A training programs at Obninsk and other training sites.
- Encourage Moscow Engineering Physics Institute to increase student participation (and its income resulting from tuition payments) in its security-oriented courses by offering an industrial security as well as an MPC&A specialization.
- Give greater attention, in both training and implementation activities, to developing personal commitments on the part of Russian managers, specialists, and guard forces to fulfill their responsibilities for ensuring the proper functioning of MPC&A systems.
- Increase opportunities for Russian input in establishing priorities at specific sites and in preparing statements of work for individual projects.

[2]NRC. 1999. *Protecting Nuclear Weapons Materials in Russia*, National Academy Press, Washington, D.C.

C

Committee Biographies

William Happer, committee chair, is professor in the Department of Physics at Princeton University. He specializes in modern optics, optical and radiofrequency spectroscopy of atoms and molecules, and spin-polarized atoms and nuclei. Dr. Happer received his Ph.D. in Physics from Princeton University in 1964. In 1964 Dr. Happer went to Columbia University to accept a position as research associate in the Columbia Radiation Laboratory. During his tenure at Columbia he served as a professor in the Department of Physics. He also served as co-director of the Columbia Radiation Laboratory from 1971 to 1976 and as director from 1976-1979. In 1980, he joined the faculty at Princeton University. He was awarded the Class of 1909 Professorship of Physics at Princeton in 1988. In August 1991 he was appointed director of energy research in the Department of Energy (DOE) by President George H. W. Bush. While serving in that capacity he oversaw a basic research budget of $3 billion, which included much of the federal funding for high energy and nuclear physics, materials science, magnetic confinement fusion, environmental science, the human genome project, and other areas. After assisting in the transition of administrations he was reappointed professor of physics at Princeton University in June 1993 and named Eugene Higgens Professor of Physics and chair of the University Research Board in 1995. Throughout his career Dr. Happer has served as a scientific consultant to numerous firms, charitable organizations, and government agencies. From 1987 to 1990 he served as chair of the steering committee of JASON, a group of mostly academic scientists and engineers who advise agencies of the federal government on matters of defense, intelligence, energy policy, and other technical problems. He was a founder of Magnetic Imaging Technologies, Inc. (now part of Nycomed

Amersham), a startup company focused on the development of magnetic resonance imaging with laser-polarized He-3 and Xe-129. In addition to having published over 160 scientific papers, he is a fellow of the American Physical Society, the American Association for the Advancement of Science (AAAS), and a member of the American Academy of Arts and Sciences, the National Academy of Sciences (NAS), and the American Philosophical Society. He was awarded an Alfred P. Sloan Fellowship in 1966, an Alexander von Humboldt Award in 1976, the 1997 Broida Prize, and the 1999 Davisson-Germer Prize of the American Physical Society.

John F. Ahearne is director of the Ethics Program at the Sigma Xi Center for Sigma Xi. Dr. Ahearne serves as a lecturer in public policy at Duke University, and an adjunct scholar at Resources for the Future. His professional interests include reactor safety, energy issues, resource allocation, and public policy management. He has served as commissioner and chairman of the U.S. Nuclear Regulatory Commission (NRC), systems analyst for the White House Energy Office, deputy assistant secretary of energy, and principal deputy assistant secretary of defense. Dr. Ahearne currently serves as vice-chair of DOE's Nuclear Energy Research Advisory Committee. He has served as chair of the National Research Council's Board on Radioactive Waste Management. In addition, Dr. Ahearne has been active on several National Research Council committees examining issues in risk assessment. He is a fellow of the American Physical Society, AAAS, the Society for Risk Analysis, and American Academy of Arts and Sciences and is a member of Sigma Xi, the American Nuclear Society, and the National Academy of Engineering (NAE). He received his B.S. and M.S. degrees from Cornell University and a Ph.D. in physics from Princeton University.

Deborah Yarsike Ball is senior Russian political-military analyst for the Proliferation and Terrorism Prevention Program at Lawrence Livermore National Laboratory (LLNL). Her work focuses on Russian civil-military relations, military doctrine and security issues, the prevention of theft of nuclear weapons and weapon-usable nuclear material from the former Soviet Union, as well as the safety and security of Russia's nuclear arsenal. Dr. Ball conducted a survey of former Soviet weapons of mass destruction scientists to assess the extent to which the International Science and Technology Center's program in Russia is meeting its nonproliferation goals. Ball's publications include: "How Safe Is Russia's Nuclear Arsenal?" in *Jane's Intelligence Review* (December 1999), "The Social Crisis of the Russian Military," in *Russia's Torn Safety Nets* (Mark G. Field and Judyth L. Twigg, eds. St. Martins, 2000) and "The State of Russian Science: Focus Groups with Nuclear Physicists" (with Theodore Gerber) in *Post-Soviet Affairs* (July-September 2002). She received her Ph.D. from the University of Michigan and has been a fellow at Harvard University's Center for Science

and International Affairs, as well as Stanford's Center for International Security and Arms Control.

Richard A. Meserve is the ninth president of the Carnegie Institution, after stepping down as chair of the NRC. Meserve served as NRC chair from October 1999 through April 2003. He was also a member of Carnegie's board of trustees beginning in 1992. Before joining the NRC, Meserve was a partner in the Washington, D.C. law firm of Covington & Burling where he also now serves as Senior of Counsel. With his Harvard law degree, received in 1975, and his Ph.D. in applied physics from Stanford, awarded in 1976, he devoted his legal practice to technical issues arising in environmental and toxic tort litigation, counseling scientific societies and high-tech companies, and nuclear licensing. Early in his career, he served as legal counsel to the President's science advisor, and was a law clerk to Justice Harry A. Blackmun of the United States Supreme Court and to Judge Benjamin Kaplan of the Massachusetts Supreme Judicial Court. Meserve has served on numerous legal and scientific committees over the years, including many chartered by the National Academies. Among other affiliations, he is a member of the American Philosophical Society and the NAE, and he is a fellow of the American Academy of Arts and Sciences, the AAAS, and the American Physical Society. Meserve serves on the board of directors of the AAAS. Dr. Meserve received a B.A. from Tufts University in 1966, a J.D. from Harvard Law School in 1975, and a Ph.D. in applied physics from Stanford University in 1976.

Mark F. Mullen is a project leader in the Nuclear Nonproliferation Division at Los Alamos National Laboratory. Mr. Mullen has participated in U.S.-Russian cooperative threat reduction programs since their inception in 1992 and was one of the principal architects of DOE's laboratory-to-laboratory MPC&A program, which sparked a rapid expansion in U.S.-Russian MPC&A cooperation beginning in 1994. From 1995 through 1997, Mr. Mullen served at DOE as advisor to the director of the Office of Arms Control and Nonproliferation and Chairman of the Lab-to-Lab Program; in this capacity, he provided strategic and technical direction to the MPC&A Program. He has also contributed to and led many other U.S.-Russian cooperative programs, for both DOE and the Department of Defense. Mr. Mullen has 28 years of experience in nuclear materials safeguards, nuclear nonproliferation and international security. He also has extensive experience in risk analysis, cost-benefit analysis, decision analysis, and nuclear safety. Mr. Mullen holds a M.S. in nuclear engineering from the University of Washington and a B.A. in mathematics, also from the University of Washington.

William C. Potter is institute professor and director of the Center for Nonproliferation Studies at the Monterey Institute of International Studies (MIIS). He also directs the MIIS Center for Russian and Eurasian Studies. He is the author of *Nuclear Profiles of the Soviet Successor States* (1993), *Soviet Decisionmaking*

for Chernobyl: An Analysis of System Performance and Policy Change (1990), and *Nuclear Power and Nonproliferation: An Interdisciplinary Perspective* (1982), co-author of *The Four Faces of Nuclear Terrorism* (2004), and *Tactical Nuclear Weapons: Options for Control* (2000), the editor of *Verification and SALT: The Challenge of Strategic Deception* (1980), *Verification and Arms Control* (1985), and *International Nuclear Trade and Nonproliferation* (1990), and the co-editor of *Dangerous Weapons, Desperate States* (1999), *Dismantling the Cold War: U.S. and NIS Perspectives on the Nunn-Lugar Cooperative Threat Reduction Program* (1997), *Soviet Decisionmaking for National Security* (1984), *The Nuclear Suppliers and Nonproliferation* (1985), *Continuity and Change in Soviet-East European Relations* (1989), and *International Missile Bazaar: The New Suppliers' Network* (1994). Dr. Potter has contributed chapters and articles to over eighty-five scholarly books and journals. He has served as a consultant to the Arms Control and Disarmament Agency, LLNL, the RAND Corporation, and the Jet Propulsion Laboratory. He has been a member of several committees of the NAS and currently serves on the NAS/Russian Academy of Sciences Joint Working Group on Nuclear Nonproliferation. His present research focuses on nuclear terrorism and on proliferation issues involving the post-Soviet states. He is a member of the Council on Foreign Relations, the Pacific Council on International Policy, and the International Institute for Strategic Studies, and served for five years on the United Nations (UN) Secretary-General's Advisory Board on Disarmament Matters and the Board of Trustees of the UN Institute for Disarmament Research. He currently serves on the International Advisory Board of the Center for Policy Studies in Russia (Moscow). He was an advisor to the delegation of Kyrgyzstan to the 1995 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) Review and Extension Conference and to the 1997, 1998, 1999, 2002, 2003 and 2004 sessions of the NPT Preparatory Committee, as well as to the 2000 and 2005 NPT Review Conferences.

D

United States Legislative Basis for DOE MPC&A Activities in Russia and DOE MPC&A Program Description

D.1 NUNN-LUGAR COOPERATIVE THREAT REDUCTION LEGISLATION[1]

[Excerpts: "Soviet Nuclear Threat Reduction Act of 1991"]

H.R. 3807 (P.L. 102-228)
Agreed to November 27, 1991
One Hundred Second Congress of the United States of America

AT THE FIRST SESSION
Begun and held at the City of Washington on Thursday, the third day of January, one thousand nine hundred and ninety-one
An act to amend the Arms Export Control Act to authorize the President to transfer battle tanks, artillery pieces, and armored combat vehicles to member countries of the North Atlantic Treaty Organization in conjunction with implementation of the Treaty on Conventional Armed Forces in Europe.
…

Part B – Findings and Program Authority

Sec. 211. National Defense and Soviet Weapons Destruction.

[1]This legislation can be accessed at http://www.fas.org/nuke/control/ctr/docs/hr3807.html.

(a) Findings – The Congress finds—

(1) that Soviet President Gorbachev has requested Western help in dismantling nuclear weapons, and President Bush has proposed United States cooperation on the storage, transportation, dismantling, and destruction of Soviet nuclear weapons;

(2) that the profound changes underway in the Soviet Union pose three types of danger to nuclear safety and stability, as follows: (A) ultimate disposition of nuclear weapons among the Soviet Union, its republics, and any successor entities that is not conducive to weapons safety or to international stability; (B) seizure, theft, sale, or use of nuclear weapons or components; and (C) transfers of weapons, weapons components, or weapons know-how outside of the territory of the Soviet Union, its republics, and any successor entities, that contribute to worldwide proliferation; and

(3) that it is in the national security interests of the United States (A) to facilitate on a priority basis the transportation, storage, safeguarding, and destruction of nuclear and other weapons in the Soviet Union, its republics, and any successor entities, and (B) to assist in the prevention of weapons proliferation.

(b) Exclusions. – United States assistance in destroying nuclear and other weapons under this title may not be provided to the Soviet Union, any of its republics, or any successor entity unless the President certifies to the Congress that the proposed recipient is committed to—

(1) making a substantial investment of its resources for dismantling or destroying such weapons;

(2) forgoing any military modernization program that exceeds legitimate defense requirements and forgoing the replacement of destroyed weapons of mass destruction;

(3) forgoing any use of fissionable and other components of destroyed nuclear weapons in new nuclear weapons;

(4) facilitating United States verification of weapons destruction carried out under section 212;

(5) complying with all relevant arms control agreements; and

(6) observing internationally recognized human rights, including the protection of minorities.

SEC. 212. AUTHORITY FOR PROGRAM TO FACILITATE SOVIET WEAPONS DESTRUCTION.

(a) In General. – Notwithstanding any other provision of law, the President, consistent with the findings stated in section 211, may establish a program as authorized in subsection (b) to assist Soviet weapons destruction. Funds for carrying out this program shall be provided as specified in part C.

(b) Type of Program. – The program under this section shall be limited to cooperation among the United States, the Soviet Union, its republics, and any successor entities to (1) destroy nuclear weapons, chemical weapons, and other weapons, (2) transport, store, disable, and safeguard weapons in connection with their destruction, and (3) establish verifiable safeguards against the proliferation of such weapons. Such cooperation may involve assistance in planning and in resolving technical problems associated with weapons destruction and proliferation. Such cooperation may also involve the funding of critical short-term requirements related to weapons destruction and should, to the extent feasible, draw upon United States technology and United States technicians.

PART C – ADMINISTRATIVE AND FUNDING AUTHORITIES

SEC. 221. ADMINISTRATION OF NUCLEAR THREAT REDUCTION PROGRAMS.

(a) Funding.—

(1) Transfer authority. – The President may, to the extent provided in an appropriations Act or joint resolution, transfer to the appropriate defense accounts from amounts appropriated to the Department of Defense for fiscal year 1992 for operation and maintenance or from balances in working capital accounts established under section 2208 of title 10, United States Code, not to exceed $400,000,000 for use in reducing the Soviet military threat under part B.

(2) Limitation. – Amounts for transfers under paragraph (1) may not be derived from amounts appropriated for any activity of the Department of Defense that the Secretary of Defense determines essential for the readiness of the Armed Forces, including amounts for—

(A) training activities; and

(B) depot maintenance activities.

(b) Department of Defense. – The Department of Defense shall serve as the executive agent for any program established under part B.

(c) Reimbursement of Other Agencies.—The Secretary of Defense may reimburse other United States Government departments and agencies under this section for costs of participation, as directed by the President, only in a program established under part B.

(d) Charges Against Funds. – The value of any material from existing stocks and inventories of the Department of Defense, or any other United States Government department or agency, that is used in providing assistance under part B to reduce the Soviet military threat may not be charged against funds available pursuant to subsection (a) to the extent that the material contributed is directed by the President to be contributed without subsequent replacement.

(e) Determination by Director of OMB. – No amount may be obligated for the program under part B unless expenditures for that program have been determined by the Director of the Office of Management and Budget to be counted against the defense category of the discretionary spending limits for fiscal year 1992 (as defined in section 601(a)(2) of the Congressional Budget Act of 1974) for purposes of part C of the Balanced Budget and Emergency Deficit Control Act of 1985.

SEC. 222. REPAYMENT ARRANGEMENTS.

(a) Reimbursement Arrangements. – Assistance provided under part B to the Soviet Union, any of its republics, or any successor entity shall be conditioned, to the extent that the President determines to be appropriate after consultation with the recipient government, upon the agreement of the recipient government to reimburse the United States Government for the cost of such assistance from natural resources or other materials available to the recipient government.

(b) Natural Resources, Etc. – The President shall encourage the satisfaction of such reimbursement arrangements through the provision of natural resources, such as oil and petroleum products and critical and strategic materials, and industrial goods. Materials received by the United States Government pursuant to this section that are suitable for inclusion in the Strategic Petroleum Reserve or the National Defense Stockpile may be deposited in the reserve or stockpile without reimbursement. Other material and services received may be sold or traded on the domestic or international market with the proceeds to be deposited in the General Fund of the Treasury.

SEC. 223. DIRE EMERGENCY SUPPLEMENTAL APPROPRIATIONS.
It is the sense of the Senate that the committee of conference on House Joint Resolution 157 should consider providing the necessary authority in the conference agreement for the President to transfer funds pursuant to this title.

PART D – REPORTING REQUIREMENTS

SEC. 231. PRIOR NOTICE OF OBLIGATIONS TO CONGRESS.

Not less than 15 days before obligating any funds for a program under part B, the President shall transmit to the Congress a report on the proposed obligation. Each such report shall specify –

(1) the account, budget activity, and particular program or programs from which the funds proposed to be obligated are to be derived and the amount of the proposed obligation; and

(2) the activities and forms of assistance under part B for which the President plans to obligate such funds.

SEC. 232. QUARTERLY REPORTS ON PROGRAM.

Not later than 30 days after the end of each quarter of fiscal years 1992 and 1993, the President shall transmit to the Congress a report on the activities to reduce the Soviet military threat carried out under part B. Each such report shall set forth, for the preceding quarter and cumulatively, the following:

(1) Amounts spent for such activities and the purposes for which they were spent.

(2) The source of the funds obligated for such activities, stated specifically by program.

(3) A description of the participation of the Department of Defense, and the participation of any other United States Government department or agency, in such activities.

(4) A description of the activities carried out under part B and the forms of assistance provided under part B.

(5) Such other information as the President considers appropriate to fully inform the Congress concerning the operation of the program under part B.

D.2 TRANSITION TO RUSSIAN FEDERATION SUPPORT OF MPC&A SYSTEMS[2]

The Bob Stump National Defense Authorization Act of 2003 mandates that a sustainable MPC&A system be transferred to sole Russian Federation support no later than January 1, 2013.

[Excerpt]

SEC 3156. (b) 1 "The Secretary of Energy shall work cooperatively with the Russian Federation to develop, as soon as practicable but no later than January 1, 2013, a sustainable nuclear materials protection, control, and accounting system for the nuclear materials of the Russian Federation that is supported solely by the Russian Federation."

D.3 DESCRIPTION OF THE U.S. DEPARTMENT OF ENERGY MATERIALS PROTECTION, CONTROL & ACCOUNTING PROGRAM[3]

Background

- The mission of the Office of International Material Protection and Cooperation is to improve security for vulnerable stockpiles of nuclear weapons, weapon-usable nuclear materials, and radiological materials in countries of concern, and to improve the ability to detect their illicit trafficking.
- Programmatic activities include installing physical security and accountancy upgrades to secure Russian nuclear weapons and weapon-usable material against theft; locating, securing and consolidating radiological materials that could be used to make dirty bombs; consolidating Russian nuclear material into fewer sites where enhanced security systems have already been installed; converting weapons grade highly enriched uranium (HEU) to low enriched uranium (LEU); and helping to secure international borders, including major seaports, against smuggling of nuclear and other radioactive materials.

Program Scope

- The program helps prevent nuclear terrorism by working in Russia and other regions of concern to: (1) secure and eliminate vulnerable nuclear weapons and weapon-usable material; (2) locate, consolidate and secure radiological mate-

[2]This document can be accessed at: http://www.defenselink.mil/dodge/olc/docs/PL107-314.pdf.
[3]Provided to the committee by DOE in April 2004.

rials that can be used in a dirty bomb; and (3) install detection equipment at border crossings and mega-seaports to prevent and detect the illicit transfer of nuclear and other radioactive materials.

- A total of 115 sites encompass work to secure and eliminate vulnerable nuclear weapons and weapon-usable material, including 51 material sites (11 Russian Navy fuel, 9 Ministry of Atom Energy weapons complex and 31 civilian), and 64 nuclear warhead sites (39 Russian Navy warhead and up to 25 Strategic Rocket Forces sites).
- A total of 313 sites encompass work to install detection equipment at border crossings and mega-seaports to prevent and detect the illicit transfer to nuclear and other radioactive materials. These sites are distributed by country/type as follows: 78 Russia, 25 Ukraine, 25 Kazakhstan, 165 other including border sites in up to 21 additional countries and 20 MegaPorts.

E

The U.S. Department of Energy's Approach to Materials Protection, Control, and Accounting Sustainability in Russia[1]

Element	Operations Principles	Sustainability Indicators
MPC&A Organization	An independent MPC&A organization on site capable of planning, resource allocation, implementation, testing and evaluating all aspects of MPC&A operations. An effective MPC&A organization has sufficient authority to carry out all aspects of their MPC&A duties and is sufficiently independent from organizations, such as those with production responsibility on site.	- Site has an established and documented MPC&A organization with clear roles and responsibilities identified. - Site has an MPC&A organization with lines of authority that provide sufficient independence of MPC&A operations. - Site has developed an MPC&A Site Operation Plan. - Site has an established and documented mechanism for coordinating activities within the site that may affect MPC&A. - Site has a budget for MPC&A operations activities and personnel.
Site Operating Procedures	Site has written operating procedures that address threats and vulnerabilities, cover key aspects of MPC&A operations, cover emergency situations on site, and are supported by site management.	- Site has evidence of written procedures covering all key MPC&A operations. - Site procedures are consistent with documented processes. - Site procedures are consistent with regulations.

[1]Provided to the committee by DOE May 2004.

Element	Operations Principles	Sustainability Indicators
		- Site has procedures for field review of operating procedures. - Site has evidence of written emergency response procedures. - Site management supports procedures.
Human Resource Management and Site Training	MPC&A staff has the requisite knowledge, skills, and abilities to perform critical MPC&A functions. Sites have capability to assess MPC&A staffing needs. Sites can apply local, regional, and national training resources to meet training needs. Sites have the capability to retrain staff to correct operational deficiencies. Sites have the capability to provide site-specific MPC&A training. Sites have a process to replace MPC&A staff with qualified training personnel.	- U.S. project team observations show performance by Russian Federation site personnel that is consistent with site operating procedures. - Site has established an on-site training organization with resources. - Site maintains class attendance records and test results. - Training requirements for each MPC&A position have been identified. - The site has a mechanism to track corrective actions from inspections and exercises and offers retraining to staff.
Operational Cost Analysis	Operational costs are understood and data are used for design decisions and for lifecycle management. System can be supported by Russian site.	- Site has identified lifecycle costs, capital equipment replacement costs, etc. - Site has established a budget for MPC&A operations, which covers site's system requirements. - Site has identified potential sources of funding to support MPC&A other than U.S. - Site, or Russian vendors performing functions at the site, has demonstrated ability (both technical and financial) to sustain MPC&A system.

Element	Operations Principles	Sustainability Indicators
Equipment Maintenance Repair and Calibration	MPC&A systems are properly maintained and operational. Minimize downtime of critical components and maximize operational life of system components.	- Site, or vendors with access to the site, have documented maintenance requirements, strategy and schedule, prioritized based on relative importance of component. - Site has adequate resources to maintain/repair MPC&A system (supply of critical spare parts, contracts covering warranties/ maintenance in place, tool kits, etc.) - Site has documented calibration plan. - Site has a database that records repair/maintenance histories. - U.S. project team observations indicate that equipment is well maintained and operating.
Performance Testing and Operational Monitoring	Sites should be able to periodically evaluate the effectiveness of the system, subsystem, and components of the system; identify and correct deficiencies; and maintain continuous and effective MPC&A operations. Sites should be able to monitor implementation of MPC&A procedures and correct operational deficiencies.	- Site has internal review system to evaluate MPC&A system performance. - Site has evidence of identifying and correcting MPC&A deficiencies. - Site provides assurance to U.S. project team that system is operating per design, and equipment is being utilized per its intended function (performance testing data, MOM system data, project team visits/checklists, GAN inspections, and/or quarterly inventory).
Configuration Management	The upgraded MPC&A system is adequately documented, and a configuration consistent with threat mitigation is established in a baseline. An administrative system of work review is in place to determine if work will change the configuration and if so, that changes are reviewed, compensatory actions taken, and documentation is updated.	- Site has configuration control plan (or similar document). - Site has established a configuration control board. - Changes to configuration are reviewed by appropriate staff to verify that system effectiveness is not degraded. - Configuration control changes are communicated to staff.

F

List of Consultations and Site Visits by the Committee

COMMITTEE VISITS IN RUSSIA

Visits to sites where MPC&A upgrades are being installed
- Institute of Physics and Power Engineering (Obninsk), *October 2004*
- Institute of Theoretical and Experimental Physics (Moscow), *October 2004*
- The Russian Research Center-Kurchatov Institute (Moscow), *October 2004*
- Luch Scientific Production Association (Podolsk), *October 2004*
- Machine Building Plant (Elektrostal), *October 2004*
- Petersburg Institute of Nuclear Physics (Gatchina), *March 2004*

Visits to organizations that manage MPC&A training programs
- Institute of Physics and Power Engineering (Obninsk), *October 2004*
- The Russian Research Center-Kurchatov Institute (Moscow), *October 2004*

Meetings with government agencies and regulatory bodies
- Gosatomnadzor (Moscow), *October 2004*
- Ministry of Atomic Energy (Moscow), *October 2004*
- Russian Federation State Duma (Moscow), *October 2004*

Other visits
- PIR Center (Moscow), October 2004
- DOE Office at the U.S. Embassy (Moscow), *October 2004*

COMMITTEE VISITS IN THE UNITED STATES

Department of Energy, *January 2003 – June 2005*
Department of Energy's National Nuclear Security Administration's Y-12 Office, *September 2004*
Y-12 National Security Complex, *September 2004*
Oak Ridge National Laboratory, *September 2004*

G

Timeline of the U.S. Department of Energy-Ministry of Atomic Energy Cooperation[1]

1993

- Signing of agreement on nuclear materials protection, control, and accounting (MPC&A) by the Russian Ministry of Atomic Energy (Minatom) and the U.S. Department of Defense, September 2, 1993

1994

- Start of cooperation at the Machine Building Plant (Elektrostal)
- Start of interlaboratory program: All-Russian Scientific Research Institute of Experimental Physics (VNIIEF, Sarov), All-Russian Scientific Research Institute of Automatics (VNIIA, Moscow), Bochvar All-Russian Scientific Research Institute of Inorganic Materials (VNIINM, Moscow), Institute of Physics and Power Engineering (IPPE, Obninsk), and Eleron (Moscow)
- Start of efforts to provide equipment and methodological support for nuclear material accounting and control (VNIIA, VNIINM, IPPE, VNIIEF)

1995

- Start of cooperation at the Mayak Production Association (Ozersk), Luch Production Association (NPO Luch, Podolsk), Scientific Research Insti-

[1]Document provided to the committee by Rosatom in May 2005. Translated from the Russian by Kelly Robbins.

tute of Atomic Reactors (NIIAR, Dimitrovgrad), All-Russian Scientific Research Institute of Technical Physics (VNIITF, Snezhinsk), and Siberian Chemical Combine (Seversk)
- Start of project for personnel training and skill enhancement (Methodological and Training Center for Nuclear Materials Accounting and Control, Interdepartmental Special Training Center, Obninsk)
- Start of work on safe transport of nuclear materials and creation of automated security system for transporters of nuclear materials (Eleron, Design Bureau for Auto Transport Equipment)

1996
- Start of project on Federal Information System for Nuclear Materials Accounting and Control (Minatom Central Scientific Research Institute of Management, Economics, and Information)
- Start of cooperation at the Novosibirsk Chemical Concentrates Plant, Radium Institute (St. Petersburg), Beloyarsk Nuclear Power Plant (Zarechny), Urals Electrochemical Integrated Plant (Novouralsk), Mining and Chemical Combine (Zheleznogorsk), Scientific Research and Design Institute of Power Technology (NIKIET, Moscow), Siberian Branch of NIKIET (Zarechny), Institute of Theoretical and Experimental Physics (ITEP, Moscow), and Electrochemical Plant (Zelenogorsk)
- Organization of joint exposition at the press center of the G-8 summit on nuclear security (House of Unions, Moscow)

1997
- Start of cooperation at Scientific Research Institute for Instruments (Lytkarino)
- Start of project on standard samples for nondestructive measurement methods (VNIINM)
- Joint tests of a trial version of the automated security system for transporters of nuclear materials on the Moscow-Yekaterinburg-Moscow route
- Start of work to improve the radio communications system to enhance physical security systems at facilities
- First Russian international conference on MPC&A (Obninsk)

1998
- Start of project on the regulatory base for MPC&A
- Official opening ceremony for the Methodological and Training Center for Nuclear Materials Accounting and Control (IPPE)
- Completion of main phase of work to modernize MPC&A systems at NIKIET, Siberian Branch of NIKIET, Beloyarsk Nuclear Power Plant, and ITEP

1999

- Signing of Russian-U.S. intergovernmental agreement on MPC&A, October 2, 1999
- Start of work on nuclear materials consolidation and conversion at NPO Luch and NIIAR
- Start of work on improving the effectiveness of department-run security at Minatom facilities

2000

- First Joint Coordinating Committee meeting (July 13-14, 2000, Moscow)
- Establishment of objectives for joint work under the intergovernmental agreement
- Reaching of agreement on development of a plan of joint actions in the long term
- Start of work on creation of a civilian plutonium registry
- Second Russian international conference on MPC&A (Obninsk)

2001

- Second Joint Coordinating Committee meeting (April 17-19, 2001, London)
- Preparation of first draft of joint plan (Minatom-U.S. Department of Energy [DOE]) for long-term cooperation on MPC&A for 2001-2010
- Signing of Memorandum on questions of access to Minatom facilities by DOE representatives
- Start of work to support departmental control (inspection and oversight) by Minatom in the field of MPC&A

2002

- Third Joint Coordinating Committee meeting (July 23-25, 2002, St. Petersburg)
- Signing of provisional procedures for the exchange of confidential information between Minatom and DOE in the course of efforts carried out under the Agreement

2003

- Fourth Joint Coordinating Committee meeting (July 30-August 1, 2003, Vienna)
- Start of work to ensure the security of radioactive sources under the MPC&A agreement (All-Russian Scientific Research Institute of Technical Physics and Automation, Izotop)
- Start of work to improve the sustainable development of modernized MPC&A systems by enhancing the infrastructure at Minatom facilities

2004

- Fifth Joint Coordinating Committee meeting (August 3-5, 2004, St. Petersburg)
- Start of work on MPC&A Operations Monitoring System project
- Completion of main phase of work to modernize MPC&A systems at the Novosibirsk Chemical Concentrates Plant

2005

- Sixth Joint Coordinating Committee meeting (February 1-3, 2005, Paris)
- Signing of plan for joint actions by Minatom and DOE within the framework of cooperation on MPC&A for the period 2005-2012
- Third Russian international conference on MPC&A (Obninsk)

H

U.S. Congressional Appropriations and Funding Projections for MPC&A Cooperative Program with the Russian Federation[1]

TABLE H.1 Congressional Funds Expended for DOE MPC&A Program, FY 1999 – FY 2003[a]

Year	Total MPC&A Expenditures (in millions of USD)	Total Naval Expenditures	MPC&A Total Expenditures Minus Naval Component
FY 1999	$132,813	$2,343	$130,470
FY 2000	$141,268	$28,763	$112,505
FY 2001	$111,407	$18,195	$93,212
FY 2002	$164,888	$40,507	$124,381
FY 2003	$172,288	$33,704	$138,584

[a]Data provided to the committee by DOE, July 2004; substantial funds were also appropriated from 1994 through 1998.

Notes:

a. FY 2002 does not include amounts spent in the following programs, since they do not secure weapon-usable material:

Second Line of Defense:	$ 12,041,000
Nuclear Assessment:	$ 5,121,000
Total:	$ 17,162,000

b. FY 2003 does not include amounts spent in the following programs since they do not secure weapon-usable material:

Radiological Dispersal Devices:	$ 8,377,000
Second Line of Defense:	$ 34,668,000
MegaPorts:	$ 1,125,000
Nuclear Assessment:	$ 4,297,000
Total:	$ 48,467,000

[1]The data in this Appendix have been presented as they were provided to the committee. The committee was not able to independently confirm the accuracy of the data, and therefore does not endorse it. However, the committee has provided it here as background information.

TABLE H.2 Proportion of DOE Funds Expended in United States and the Former Soviet Union (FSU), FY 1999 – FY 2003[a]

Year	U.S./Other Country Costs	FSU Costs*
FY 1999	51%	49%
FY 2000	41%	59%
FY 2001	51%	49%
FY 2002	46%	54%
FY 2003	46%	55%

[a]Data provided to the committee by DOE, July 2004.

* This figure includes equipment delivered to the FSU, whether purchased in the U.S. or Russia.

Note: This table does include the Second Line of Defense and Navy Programs.

TABLE H.3 Total Cost of MPC&A Equipment Purchased in Russia, FY 1999 – FY 2003[a]

Year	Cost of Russian Equipment*
FY 1999	$20,133
FY 2000	$74,708
FY 2001	$48,660
FY 2002	$81,813
FY 2003	$96,969

[a]Data provided to the committee by DOE, July 2004.

* Figures provided in millions of U.S. dollars.

Note: This table does include the Second Line of Defense and Navy Programs.

TABLE H.4 Congressional Funding for DOE MPC&A Program, FY 2005 and Projected Requests for FY 2006 – 2009[a]

FY 2005 Request*	FY2006*	FY2007*	FY2008*	FY2009*
114 million	126 million	124 million	122 million	89 million

[a]Data provided to the committee by DOE, January 2005.

* These figures do not include Second Line of Defense, Radiological Threat Reduction or Navy/Strategic Rocket Forces Programs.

I

Russian Facilities Participating in the Cooperative MPC&A Program as of June 2005[1]

DEFENSE-RELATED SITES

Uranium and Plutonium Cities

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

Nuclear Weapons Complex

6. Sverdlovsk-45/Lesnoy, Electrochemical Instrument Combine
7. Arzamas-16/Sarov, All-Russian Scientific Research Institute of Experimental Physics
8. Chelyabinsk-70/Snezhinsk, All-Russian Scientific Research Institute of Technical Physics
9. Avangard Plant (Merged with Arzamas-16)
10. Penza-19/Zarechny, Production Association START
11. Zlatoust-36/Trekhgorny, Instrument Building Plant

[1]Information provided by DOE, as quoted in: National Research Council. 1999. *Protecting Nuclear Weapons Materials in Russia*, National Academy Press, Washington, D.C. This information was verified by DOE in July 2004.

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 Civilian Sites

Large Fuel Facilities

21. Elektrostal Production Association Machine Building Plant
22. Novosibirsk Chemical Concentrates Plant
23. Luch Scientific Production Association, Podolsk
24. Dimitrovgrad, Scientific Research Institute of Atomic Reactors
25. Obninsk, Institute of Physics and Power Engineering
26. Bochvar All-Russian Scientific Research Institute of Inorganic Materials
27. Nizhny Novgorod Experiment Design Bureau of Machine Building

Reactor Facilities

28. Dubna, Joint Institute of Nuclear Research
29. Scientific Research and Design Institute of Power Technology
30. Moscow Institute of Theoretical and Experimental Physics
31. Moscow State Engineering Physics Institute
32. Karpov Institute of Physical Chemistry
33. Beloyarsk Nuclear Power Plant
34. Sverdlovsk Branch of Scientific Research and Design Institute of Power Technology
35. Khlopin Radium Institute
36. Tomsk Polytechnical University
37. St. Petersburg Nuclear Physics Institute
38. Krylov Shipbuilding Institute
39. Lytkarino Research Institute of Scientific Instruments

J

Russian Federal Target Program on Nuclear and Radiation Safety in Russia for 2000–2006[1]

AFFIRMED
By resolution of the Government
Of the Russian Federation
February 22, 2000, No. 149

FEDERAL TARGETED PROGRAM
ON NUCLEAR AND RADIATION
SAFETY AND SECURITY IN RUSSIA[2]
FOR 2000-2006

BASIC INFORMATION

Program Name	Federal Targeted Program on Nuclear and Radiation Safety in Russia for 2000-2006
Basis for Development of Program	Order No. Pr-2214 of the President of Russia, dated December 11, 1996

[1]This Russian resolution provided to the committee by Russian experts in March 2004.

[2]In Russian, the same word is used for safety and for security. Translated from the Russian by Kelly Robbins.

State Contractor–Program Coordinator	Russian Federation Ministry of Atomic Energy
State Contractors on Program	Russian Federation Ministry of Atomic Energy; Russian Federation Ministry on Civil Defense, Extreme Situations, and Elimination of the Consequences of Natural Disasters; Russian Federation Ministry of Health; Russian Federation Ministry of Science and Technology; Russian Federation Ministry of Economics; Russian Federation State Committee on Environmental Protection; Russian Shipbuilding Agency; Russian Federal Inspectorate on Nuclear and Radiation Security
Primary Executors of Program	Scientific research and experimental design organizations and enterprises of the Russian Federation Ministry of Atomic Energy; Russian Federation Ministry of Internal Affairs; Russian Federation Ministry on Civil Defense, Extreme Situations, and Elimination of the Consequences of Natural Disasters; Russian Federation Ministry of Health; Russian Federation Ministry of Defense; Russian Federation Ministry of Education; Russian Federation Ministry of Natural Resources; Russian Federation Ministry of Railways; Russian Federation Ministry of Agriculture and Food; Russian Federation Ministry of Fuel and Energy; Russian Federation Ministry of Transportation; Russian Federation Ministry of Economics; Russian Federation Ministry of Justice; Russian Federation State Committee on Environmental Protection; Russian Federation State Committee on Standardization and Metrology; Russian Federation State Committee on Construction and the Housing and Public Utilities Complex; Russian Federation State Committee on Customs; Russian Federal Service for Hydrometeorology and Environmental Monitoring; Russian Federation Federal Security Service; Russian Federal Forestry Service; Russian Shipbuilding Agency; Russian Federal Inspectorate for Nuclear and Radiation Security; Federal Administration for Medical-Biological and Emergency Problems of the Russian Federation Ministry of Healthcare; Russian Academy of Sciences; Russian Academy of Architecture and Construction Sciences; Russian Academy of Medical Sciences; Russian Academy of Agricultural Sciences; the Kurchatov Institute Russian Science Center; and other organizations as determined on a competitive basis in accordance with the Federal Law on Competitions for the Awarding of Orders to Supply Goods, Complete Work, and Provide Services to Meet State Needs
Primary Developers of Program	Russian Federation Ministry of Atomic Energy; Academician A. I. Leipunsky Institute of Physics and Power Engineering State Science Center
Goal and Basic Objectives of Program	The goal of the Program is to comprehensively address problems of ensuring the nuclear and radiation safety of the state with the aim of reducing to a socially acceptable level the risk of radiation effects on humans and their living environment arising from the operation of atomic energy facilities and natural and manufactured sources of ionizing radiation.

The basic objectives of the Program are as follows:

- Comprehensively addressing problems related to the management of radioactive wastes and spent nuclear materials in order to prevent their harmful impact on humans and the environment
- Ensuring nuclear and radiation safety at enterprises involved in the nuclear fuel cycle
- Ensuring safety for active and decommissioned atomic power stations, experimental and research reactors, and critical and subcritical stands
- Developing promising means of using atomic energy while ensuring an increased level of nuclear and radiation safety, including by replacing more environmentally dangerous technologies
- Improving the system for training, retraining, and professional development for personnel in the atomic energy field
- Developing the system for state accounting and control of nuclear materials and the system for state accounting and control of radioactive substances and radioactive wastes
- Improving the physical protection of nuclear materials, nuclear facilities, and nuclear material storage sites
- Ensuring nuclear and radiation safety at shipbuilding enterprises during the construction, repair, and dismantlement of atomic submarines and nuclear-powered ships of the Russian Navy as well as nuclear-powered ships and nuclear maintenance ships of the Russian Federation Ministry of Transportation
- Ensuring the readiness of management agencies and the forces and means of territorial and functional subsystems of the unified state system for preventing and eliminating the consequences of extreme situations so that they can accomplish objectives related to preventing and eliminating the consequences of radiation-related extreme situations within the Russian Federation
- Improving existing technologies and developing new ones for rehabilitating territories and industrial facilities subjected to radioactive contamination
- Improving state monitoring of the radiation situation within the Russian Federation
- Ensuring radiation safety with regard to the operation of industrial enterprises that use materials containing natural radionuclides
- Developing and improving the system of medical-sanitary service and labor protection for workers at nuclear and radiation hazard facilities and for risk groups in the population subjected to increased levels of radiation effects
- Managing informational-analytical databases with regard to protecting the health of the population and atomic energy industry workers against the effects of various sources of ionizing radiation
- Developing methods and means for the long-term prediction of the safe operation of atomic energy facilities with regard to their safety to humanity and the environment
- Developing and implementing federal norms and rules on atomic energy use to establish requirements for nuclear and radiation safety (technical and sanitary-hygienic aspects), physical protection, and accounting and control of nuclear materials, radioactive substances, and radioactive wastes

Terms and Stages of Program Implementation	2000 – 2006 Stage I: 2000-2001 Stage II: 2002-2003 Stage III: 2004-2006
List of Subprograms	The Program includes 20 subprograms: • Management of radioactive wastes and spent nuclear materials, including their reprocessing and burial • Safety of the Russian atomic industry • Safety of atomic power stations and nuclear research reactors • New generation atomic power stations and nuclear reactors with increased safety features • Improvement of the system for training, retraining, and professional development of personnel • Organization of the system of state accounting and control of nuclear materials and the system of state accounting and control of radioactive substances and radioactive wastes • Nuclear and radiation safety at shipbuilding industry enterprises • Protection of the population and territories from the consequences of possible radiation accidents • Methodological support for activities to protect the population and rehabilitate territories subjected to radioactive contamination • Creation of a unified automated state system for monitoring the radiation situation in the territory of the Russian Federation • Reducing the level of radiation exposure to the population and technogenous contamination of the environment due to natural radionuclides • Organization of a unified state system for control and accounting of individual doses of radiation received by citizens and the health status of risk groups in the population who have been subjected to increased levels of radiation effects • Organization of a system of medical care and labor protection for workers subjected to radiation at their work sites • Organization of a system of medical care for persons from risk groups in the population who have been subjected to increased levels of radiation effects • Provision of specialized medical care in connection with eliminating the consequences of radiation accidents • Means and methods of studying and analyzing the effects of nuclear and radiation hazard facilities on the environment and humanity • Methods of analyzing and providing scientific justification for the safety of facilities presenting nuclear and radiation danger • Strategy for ensuring the nuclear and radiation safety of Russia • Development of federal norms and rules on nuclear safety and radiation safety (technical aspects) • Development of federal norms and rules on radiation safety (sanitary-hygienic aspects)

Volume and Sources of Program Funding	The volume of funding for the Program is 7,616,330,000 rubles[3] (not including funds from the budgets of Russian Federation subjects, the volume of which is determined during the course of Program implementation) Sources of funding: • Federal budget funds – 6,066,330,000 rubles, of which 2,075,550,000 rubles are to be spent on scientific research and experimental design work, 3,410,700,000 rubles on investment expenses, and 580,080,000 rubles on other costs • Non-budget sources – 1,550,000,000 rubles (to be spent on various measures to the extent they are received)
Expected End Results of Program Implementation	• Development and use of modern technologies for safe operations in the management of radioactive wastes and spent nuclear materials and the reprocessing and reliable isolation of radioactive wastes and spent nuclear materials • Development and implementation at nuclear fuel cycle enterprises of nuclear-, radiation-, explosive-, and fire-safe technologies as well as safer equipment • Improvement of systems which diagnose the operational status of units and equipment at atomic power stations and nuclear research reactors as well as an increase in the technical quality of their maintenance and servicing • Development of designs for promising new nuclear reactors for various purposes and types with increased levels of nuclear and radiation safety and improved technical and economic characteristics • Training of operating personnel at atomic energy facilities using modern technical means created for this purpose and on the basis of educational-methodological innovations including elements of psychological preparation of personnel for operations under extreme conditions • Creation and operation of the system of state accounting and control of nuclear materials and the state system of accounting and control of radioactive substances and radioactive wastes • Prevention of nuclear terrorism and reduction of the likelihood of losses, thefts, and unauthorized use of nuclear materials • Development of planning and design documentation and technological blueprints for ensuring nuclear and radiation safety during the dismantlement of the reactor blocks from atomic submarines and ships and during the handling of nuclear fuel and radioactive wastes at shipbuilding industry enterprises • Reduction of the risk of exceeding allowable radiation dose limits to the population, minimization of the number of exposed individuals and radiation doses in the event of radiation accidents, and reduction of the consequences of such accidents for territories and industrial facilities

[3]This was equivalent to $264 million at the 2/22/00 exchange rate.

- Return to productive use of industrial facilities, agricultural lands, and other territories subjected to radioactive contamination as a result of defense program operations or radiation-related extreme situations
- Development and operation of a modern unified automated state system for monitoring the radiation situation within the territory of the Russian Federation
- Reduction of the human irradiation level from natural radionuclides at home and on the job and reduction of technogenic contamination of the environment by such materials
- Development of modern methods and equipment for conducting medical investigations, prophylaxis, and treatment of workers at nuclear and radiation hazard facilities and of risk groups in the population who have been subjected to increased levels of radiation effects
- Creation and operation of a unified state system for control and accounting of individual radiation doses received by citizens; establishment of a state radiation epidemiological registry of persons who have suffered from radiation effects and have been subjected to radiation exposure as a result of Chernobyl and other radiation catastrophes and incidents; operation of a unified medical-dosimetric registry for atomic industry workers; and preparation of radiation-hygiene data sheets on organizations and territories
- Development of a scientifically grounded long-term strategy for ensuring nuclear and radiation safety for humanity and the environment while using atomic energy in various sectors of the economy, medicine, and scientific research
- Improvement of the regulatory and legal base with regard to defining requirements for the safe use of atomic energy in various sectors of the economy, medicine, and scientific research

System for Monitoring Program Implementation	Activities to implement Program measures are coordinated by the Russian Federation Ministry of Atomic Energy. Program implementation is monitored according to procedures established for monitoring the implementation of federal targeted programs.

EXPLANATION OF PROBLEM AND BASIS FOR THE NEED TO RESOLVE IT USING PROGRAMMATIC METHODS

The Federal Targeted Program on Nuclear and Radiation Safety in Russia (hereafter referred to as the Program) was developed in accordance with Order No. Pr-2214 of the President of the Russian Federation, dated December 11, 1996.

As a result of the production of nuclear weapons materials, the operation of nuclear power plants, the activities of nuclear fuel cycle enterprises, the operation of nuclear submarines and nuclear-powered ships, and other types of activities related to the use of atomic energy in the Russian Federation, a significant amount of radioactive wastes and spent nuclear fuel has accumulated, and its management presents a serious problem.

An unfavorable radiation situation developed in areas that have suffered

from accidents at the Chernobyl Nuclear Power Plant and other nuclear and radiation hazard facilities, as well as in areas where nuclear-powered ships are dismantled.

In connection with the further development of atomic energy, the use of atomic energy for civilian and defense purposes, and the use of ionizing radiation sources in medicine, industry, and agriculture, ensuring nuclear and radiation safety is becoming one of the most important elements of the national security of the state.

The complexity involved in addressing this problem arises from the fact that in the past the necessary attention was not paid to developing a methodology for the comprehensive analysis of questions related to Russia's nuclear and radiation security and the long-term forecasting of its status.

Under present conditions, the goal of state policy must be to minimize radiation effects on humanity and its living environment by significantly increasing the safety of existing and planned atomic energy facilities, ensuring the safe management of radioactive wastes and spent nuclear materials, and taking special measures for the radiation protection of the population, the rehabilitation of contaminated territories, and the physical protection of nuclear materials and nuclear facilities.

The problem of Russia's nuclear and radiation safety and security demands a unified approach at the state level to evaluate the danger of hazardous radiation facilities and develop measures and criteria for ensuring that their operations are safe for humanity and the environment.

The Program's system of criteria for ensuring the safety of humanity and its living environment is formed on the basis of the concept of socially acceptable risk, which is applicable to any type of natural or technogenic effect on humanity and the environment, including those associated with atomic energy and ionizing radiation. The socially acceptable condition in the assessment of the risk of possible serious accidents involving a catastrophic level of radioactive emissions is the complete exclusion of the possibility of such accidents. In cases of possible radiation incidents, social measures must be planned to protect the population and organize its day-to-day activities under conditions of increased radiation effects.

Tasks related to ensuring nuclear and radiation safety at present are addressed within the framework of numerous federal targeted programs (Management of Radioactive Wastes and Spent Nuclear Materials and Their Reprocessing and Burial for 1996-2005, Creation of a Unified Automated State System for Monitoring the Radiation Situation within the Territory of the Russian Federation, and so forth) as well as programs by various federal executive-branch agencies and executive branch agencies of Russian Federation subjects.

The lack of coordination among these programs leads to duplication on a number of issues studied in the programs. The measures in certain programs only indirectly touch on nuclear and radiation safety, and there is a lack of a common

understanding of principles and criteria in the area of nuclear and radiation safety. The situation is also complicated by the lack of appropriate funding.

These circumstances create the need for resolving the problem of ensuring nuclear and radiation safety by programmatic-targeted methods by including all aspects of this problem being addressed today under separate programs into a unified federal targeted program.

In order to carry out this Program, plans call for coordinated activities by interested federal executive branch agencies, executive branch agencies of Russian Federation subjects, and organizations regardless of their form of ownership.

Comprehensive efforts to address the problem of ensuring nuclear and radiation safety within the Program framework will make it possible to cut expenditures of federal budget funds by eliminating duplication of measures called for in a number of existing programs, focusing efforts on top priority objectives in this area by applying modern methods and means of analysis and forecasting, and developing a long-term strategy for ensuring the nuclear and radiation safety and security of the state.

Ensuring nuclear and radiation safety and security at enterprises in the nuclear weapons complex is carried out in conjunction with the Program. Specific measures are implemented and financed in accordance with the resolution of the Government of the Russian Federation that was adopted on this question.

Matters related to the rendering of social assistance to members of the population subjected to radiation effects in various regions of the Russian Federation are resolved within the framework of existing presidential and federal targeted programs, the state contractor of which is the Russian Federation Ministry on Civil Defense, Extreme Situations, and Elimination of the Consequences of Natural Disasters.

GOAL AND OBJECTIVES OF THE PROGRAM

The primary goal of the Program is to comprehensively address the problem of ensuring the nuclear and radiation safety and security of the state with the aim of reducing to a socially acceptable level, the risk of radiation effects on humanity and its living environment due to the use of atomic energy and technogenic and natural sources of ionizing radiation.

In order to achieve this goal, it is necessary to accomplish the following basic objectives:

- comprehensively resolving the problem of the management of radioactive wastes and spent nuclear materials in order to prevent their harmful impact on humanity and the environment
- ensuring the nuclear and radiation safety of nuclear fuel cycle enterprises
- ensuring the safety of existing and decommissioned atomic power stations, experimental and research reactors, and critical and subcritical stands

- developing promising means of using atomic energy while ensuring an increased level of nuclear and radiation safety, including by replacing more environmentally dangerous technologies
- improving the system of training, retraining, and professional development for atomic energy industry personnel
- developing the system of state accounting and control of nuclear materials and the system of state accounting and control of radioactive substances and radioactive wastes
- improving the physical protection of nuclear materials, nuclear facilities, and nuclear material storage sites
- ensuring nuclear and radiation safety at shipbuilding industry enterprises during the construction, repair, and dismantlement of atomic submarines and nuclear-powered ships of the Russian Navy and nuclear-powered ships and nuclear maintenance ships of the Russian Federation Ministry of Transportation
- ensuring the readiness of management agencies and the forces and means of territorial and functional subsystems of the unified state system for preventing and eliminating the consequences of extreme situations so that they can accomplish objectives related to preventing and eliminating the consequences of radiation-related extreme situations within the Russian Federation
- improving existing technologies and developing new ones for rehabilitating territories and industrial facilities subjected to radioactive contamination
- improving state monitoring of the radiation situation within the Russian Federation
- ensuring radiation safety with regard to the operation of industrial enterprises that use materials containing natural radionuclides
- developing and improving the system of medical-sanitary services and labor protection for workers at hazardous nuclear and radiation facilities and for risk groups in the population subjected to increased levels of radiation effects
- managing informational-analytical databases with regard to protecting the health of the population and atomic energy industry workers against the effects of various sources of ionizing radiation
- developing methods and means for the long-term prediction of the safe operation of atomic energy facilities with regard to their safety to humanity and the environment
- developing and implementing federal norms and rules on atomic energy use to establish requirements for nuclear and radiation safety (technical and sanitary-hygienic aspects), physical protection, and accounting and control of nuclear materials, radioactive substances, and radioactive wastes

These objectives will be accomplished on the basis of the Federal Law on the Use of Atomic Energy, the Federal Law on Radiation Safety for the Population, and other regulatory and legal acts. The following fundamental principles for ensuring radiation safety will also be taken into account:

- not exceeding allowable limits for individual radiation doses received by citizens from all sources of ionizing radiation (the normative principle)
- prohibiting all types of activities involving the use of ionizing radiation sources in which the benefit to humanity and society does not exceed the risk of potential harm caused by additional radiation beyond the natural background level (the reasonability principle)
- keeping individual radiation doses and the number of persons irradiated through the use of any ionizing radiation source to the lowest achievable level, taking economic and social factors into account (the optimization principle)

TERMS AND BASIC STAGES OF PROGRAM IMPLEMENTATION

The program is scheduled to last 7 years and is to be carried out in three stages.

During Stage I (2000-2001), plans call for determining the most effective means and measures for overcoming the negative consequences of the use of atomic energy and technogenic and natural sources of ionizing radiation. Scientific, regulatory, methodological, and organizational foundations for the further implementation of Program measures are to be developed. Capabilities are to be clarified and a mechanism worked out for attracting and utilizing federal budget funds, funds from the budgets of Russian Federation subjects, and non-budgetary sources for implementation of the Program.

During Stage II (2002-2003), coordinated interrelated efforts are to be made to carry out Program measures in all subprograms.

During Stage III (2004-2006), plans call for implementing the fundamental provisions of the Program and defining future measures to be taken in this area on the basis of the long-term strategy developed within the Program framework for ensuring nuclear and radiation safety for humanity and the environment.

The operation of the Program may be extended for a longer term according to established procedures.

SYSTEM OF PROGRAMMATIC MEASURES

In order to implement the Program, a range of interconnected and coordinated measures are to be planned in 20 subprograms, which are structurally organized in five categories.

The following basic measures are planned under Category 1, Nuclear and Radiation Hazard Facilities:

- improving technologies for managing radioactive wastes and spent nuclear materials

- creating storage sites and repositories for radioactive wastes and spent nuclear fuel
- taking measures to ensure environmental safety in regions where underground nuclear explosions were detonated for civilian purposes
- improving technologies for managing radioactive wastes formed during the operation and dismantlement of nuclear-powered ships of the Russian Federation Ministry of Transportation
- developing and implementing promising nuclear-, radiation-, explosive-, and fire-safe technologies, as well as safer equipment
- improving the quality of technical service and repair of systems and equipment at nuclear power plants
- creating a system for preventing and eliminating the consequences of extreme situations at nuclear power plants and other nuclear and radiation hazard facilities, including crisis centers and research and consultative centers
- developing the material-technical and organizational base for emergency rescue units of the Russian Federation Ministry of Atomic Energy in the aim of ensuring their readiness to carry out emergency rescue efforts
- carrying out scientific research and experimental design work to improve the nuclear and radiation safety of the atomic industry fuel cycle by using fast neutron reactors
- developing and implementing training and methodological aids and modern technical means of instruction, including full-scale training simulators, at educational and training points and centers at nuclear power plants and nuclear fuel cycle enterprises
- improving the accounting and control of nuclear materials, radioactive substances, and radioactive wastes as well as the physical protection of facilities that use atomic energy
- developing transportation engineering plans for managing spent nuclear fuel, radioactive wastes and reactor blocks at shipbuilding industry enterprises

The following basic measures are called for under Category II, Protection of the Population, Rehabilitation of Contaminated Territories, and Monitoring of the Radiation Situation:

- developing modern means for the individual and collective protection of the population and personnel serving in units taking part in the elimination of the consequences of extreme situations
- improving the automated information and management system for prevention and action in extreme situations related to radiation accidents
- developing the necessary regulatory and methodological base in accordance with Russian Federation legislation regarding protection of the population and territories from extreme radiation situations due to natural and technogenic causes

- providing technical and organizational support for the unified state automated system for monitoring of the radiation situation within the territory of the Russian Federation (EGASKRO)
- conducting environmental hygiene studies of territories, facilities, and risk groups in the population that have been subjected to increased levels of exposure to natural radionuclides
- carrying out rehabilitation measures in areas and facilities where high levels of radon and other natural radionuclides have been detected

The following basic measures are planned under Category III, Protection of the Health of the Population and Professional Personnel from Various Types of Radiation Effects:

- developing and operating a unified state system for control and accounting of individual doses of radiation received by citizens
- carrying out scientific research and experimental design work to study working conditions and the health status of personnel at hazardous nuclear and radiation facilities; developing means and methods of prophylaxis, diagnosis, and treatment of work-related illnesses
- improving the system and means of individual protection of personnel at nuclear and radiation hazard facilities
- improving the system of medical-sanitary care for the population, including radiation monitoring of raw and processed food products
- ensuring that specialized radiation hygiene units at the federal, regional, and agency levels are constantly ready for action under emergency conditions

The following basic measures are planned under Category IV, Scientific Methodological Support for Nuclear and Radiation Security Activities:

- developing modern methods and means of studying and analyzing the behavior of radioactive substances in natural environments (hydrosphere, atmosphere, biosphere) and evaluating the status of radiation-contaminated ecosystems
- developing scientific methodology and software for reliably analyzing the safety of hazardous nuclear and radiation facilities
- developing scientific analytical foundations and risk evaluation methods for application to problems of ensuring radiation safety for humanity and the environment
- carrying out conceptual studies to provide the scientific basis for new designs of nuclear power reactors and other hazardous nuclear and radiation facilities that will have the maximum possible level of self-protection, with these efforts to include development of principles for creating new technologies for reprocessing spent nuclear materials in order to reduce environmental risk

- developing a long-term strategy, principles, and criteria for ensuring the nuclear and radiation safety of Russia, taking into account the introduction of modern technologies related to the use of atomic energy

The following basic measures are planned under Category V, State Regulation of Nuclear and Radiation Safety with Regard to the Use of Atomic Energy:

- developing criteria, principles, and basic requirements for ensuring the nuclear and radiation safety of existing and planned atomic power stations
- developing federal norms and rules regarding the nuclear and radiation safety of enterprises and plants involved in the nuclear fuel cycle
- developing sanitary norms and rules regarding radiation safety for personnel at nuclear and radiation hazard facilities
- developing sanitary norms and rules regarding radiation safety for the population

EXPECTED RESULTS OF PROGRAM IMPLEMENTATION

The following results will be achieved through implementation of measures called for in the Program:

- development and use of modern technologies for safe operations in the management of radioactive wastes and spent nuclear materials and the reprocessing and reliable isolation of radioactive wastes and spent nuclear materials
- development and implementation at nuclear fuel cycle enterprises of nuclear-, radiation-, explosive-, and fire-safe technologies as well as safer equipment
- improvement of the system for operational diagnosis of the condition of units and equipment at nuclear power plants and research reactors and improvement of the technical quality of their maintenance
- development of designs for various types of promising nuclear reactors for various purposes with an increased level of nuclear and radiation safety and improved technical and economic characteristics
- training of operating personnel at facilities that use atomic energy through the use of modern technical means created specially for this purpose and on the basis of training and methodological innovations including elements of psychological training of personnel for operations under extreme conditions
- creation and operation of the system of state accounting and control of nuclear materials and the system of state accounting and control of radioactive substances and radioactive wastes
- prevention of nuclear terrorism and the reduction of the likelihood of losses, thefts, and unauthorized use of nuclear materials

- development of planning and design documentation and technological blueprints for ensuring nuclear and radiation safety during the dismantlement of the reactor blocks from atomic submarines and ships and during the handling of nuclear fuel and radioactive wastes at shipbuilding industry enterprises
- reduction of the risk of exceeding allowable limits on radiation doses to the population, minimization of the number of exposed individuals and radiation doses in the event of radiation accidents, and reduction of the consequences of such accidents for territories and industrial facilities
- return to productive use of industrial facilities, agricultural lands, and other territories subjected to radioactive contamination as a result of defense program operations or radiation-related extreme situations
- development and operation of a modern unified automated state system for monitoring the radiation situation within the territory of the Russian Federation
- reduction of the human irradiation level from natural radionuclides at home and on the job and reduction of technogenic contamination of the environment by such materials
- development of modern methods and equipment for conducting medical investigations and prophylaxis and treatment of workers at nuclear and radiation hazard facilities and of risk groups in the population who have been subjected to increased levels of radiation effects
- creation and operation of a unified state system for control and accounting of individual radiation doses received by citizens; establishment of a state radiation epidemiological registry of persons who have suffered from radiation effects and have been subjected to radiation exposure as a result of Chernobyl and other radiation catastrophes and incidents; operation of a unified medical-dosimetric registry for atomic industry workers; and preparation of radiation-hygiene data sheets on organizations and territories
- development of a scientifically grounded long-term strategy for ensuring nuclear and radiation safety for humanity and the environment while using atomic energy in various sectors of the economy, medicine, and scientific research
- improvement of the regulatory and legal base with regard to defining requirements for the safe and secure use of atomic energy in various sectors of the economy, medicine, and scientific research

RESOURCE SUPPORT FOR PROGRAM

The Program is to be financed from the following sources:

- federal budget funds
- funds from the budgets of Russian Federation subjects

- non-budgetary sources, including funds from enterprises and organizations that operate facilities using atomic energy

In 2000, Program activities are to be financed with funds stipulated in the Federal Law on the Federal Budget for 2000 to be used for implementing federal targeted programs that are part of the Program.

Over the course of Program implementation, specific measures and the amounts and sources of their financing are subject to annual revision based on an analysis of results achieved and with consideration for the real economic possibilities of the federal budget.

The volume of financing for the Program, without taking into account the funds from budgets of Russian Federation subjects, is 7,616,330,000 rubles, of which 6,066,330,000 rubles come from the federal budget and 1,550,000,000 rubles from non-budgetary sources (to be spent on various Program measures to the extent they are received).

Program measures and their financing using federal budget funds are listed in Appendix 1.[3] A total of 1,090,830,000 rubles is required for implementation of Program measures in Stage I (2000-2001), 1,676,780,000 rubles for Stage II (2002-2003), and 3,298,720,000 for Stage III (2004-2006).

The distribution of federal budget funds for scientific research, experimental design work, investments, and other expenses is presented in Appendix 2, delineated by subprograms. A total of 2,075,550,000 rubles is allocated for scientific research and experimental design work, 3,410,700,000 rubles for investments, and 580,080,000 for other expenses.

Participation in Program implementation and financing of measures to increase the safety and security of hazardous nuclear and radiation facilities from the budget funds of Russian Federation subjects is determined by agreements between the state contractors of the Program and the corresponding Russian Federation subjects.

MECHANISM FOR PROGRAM IMPLEMENTATION

The state contractors for the Program are the Russian Federation Ministry of Atomic Energy (Program coordinator); the Russian Federation Ministry on Civil Defense, Extreme Situations, and Elimination of the Consequences of Natural Disasters; the Russian Federation Ministry of Health; the Russian Federation Ministry of Science and Technology; the Russian Federation Ministry of Economics; Russian Federation State Committee on Environmental Protection; Russian Shipbuilding Agency; and the Russian Federal Inspectorate for Nuclear and Radiation Safety.

[3]Appendixes have not been included here.

The state contractor-coordinator organizes the work of the state contractors on the Program.

Taking into account the financial resources allocated for Program implementation from various sources and the preliminary results achieved in the course of implementation, the state contractor-coordinator of the Program clarifies Program measures, their implementation timelines, and their funding volumes.

Program activities supported by federal budget resources are financed by targeted allocations through state contractors or primary executors of programmatic measures in accordance with Appendix 1 and according to the expense categories shown in Appendix 2.

Organizations and enterprises carry out Program measures on the basis of state contracts.

In the event that several enterprises (organizations) have the right based on Russian Federation legislation to participate in the implementation of programmatic measures, specific executors are determined on a competitive basis in accordance with the Federal Law on Competitions for the Awarding of Contracts for the Supply of Goods, Completion of Work, and Provision of Services to Meet State Needs.

Preliminary work within the Program framework to address various aspects singled out during the Program implementation process with regard to ensuring nuclear and radiation safety and security in various economic sectors and regions of the Russian Federation is to be carried out in accordance with the decision of the Program directorate.

ORGANIZATION OF PROGRAM MANAGEMENT AND MONITORING OF PROGRAM IMPLEMENTATION

Organization of Program management and monitoring of the course of its implementation are the responsibilities of the Russian Federation Ministry of Atomic Energy.

The state contractor-coordinator and state contractors of the Program perform their functions in coordination with interested federal executive branch agencies, executive branch agencies of Russian Federation subjects, and local government entities.

A directorate headed by the first deputy minister of the Russian Federation Ministry for Atomic Energy is being created to handle day-to-day management. The directorate also includes representatives of all the state contractors. Representatives of other interested federal executive branch agencies may also participate in the work of the directorate. The membership and status of the directorate are approved by the state contractor-coordinator of the Program.

The budgetary request for allocations from the federal budget for Program financing is developed and presented according to established procedures by the state contractor-coordinator of the Program.

In the aim of organizing the expert review of materials received from competition participants wishing to participate in the implementation of programmatic measures, assessments of interim results of Program implementation, evaluation of the reasonableness of requests for funding and material-technical support for projects, and consideration of other scientific-technical questions, the Russian Federation Ministry of Atomic Energy is organizing an interagency council of scientists and specialists from interested federal executive branch agencies, executive branch agencies of Russian Federation subjects, and organizations involved in ensuring nuclear and radiation safety. The composition and status of the interagency council are approved by the Russian Federation Ministry of Atomic Energy.

In cooperation with the state contractors of the Program, the state contractor-coordinator follows established procedures for presenting the necessary information about the course of Program efforts and the effectiveness of the use of financial resources.

Expert reviews of the course of Program implementation are carried out by the Russian Federation Ministry of Economics in cooperation with the Russian Federation Ministry of Finances, the Russian Federation Ministry of Science and Technology, and the Russian Federation Ministry of Atomic Energy.

SOCIOECONOMIC EFFECTIVENESS OF THE PROGRAM

The overall socioeconomic effect of Program implementation is achieved through

- improvement of the radiation ecology situation in areas where atomic energy facilities operate and in rehabilitated territories
- reduction in direct and indirect economic losses as a result of the elimination of the likelihood that serious radiation accidents will occur
- prevention or reduction of the possible damage from increased radiation effects on humanity and the environment as a result of a worsened radiation situation by means of taking operational actions to localize and eliminate its consequences
- effective operation of the medical-sanitary system for protecting the health of individuals employed at nuclear and radiation hazard facilities and of the population living in adjacent territories