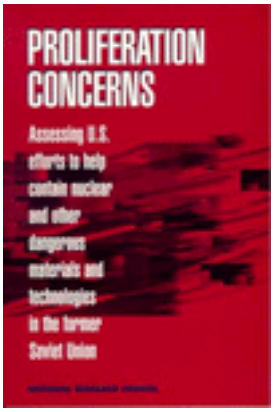

Proliferation Concerns: Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union

Committee on International Security and Arms Control, National Research Council

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PROLIFERATION CONCERNS

Assessing U.S. Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union

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ORIGIN OF THE STUDY

Following the collapse of the Soviet Union, there were alarming reports of inadequate control of nuclear weapons and nuclear material in the successor states. In response, the U.S. Congress enacted the Soviet Nuclear Threat Reduction Act of 1991, commonly referred to as the Nunn-Lugar initiative. One object of the initiative was to assist Russia and other successor states of the former Soviet Union (FSU) in reducing the likelihood of proliferation from these countries of materials, equipment, and technology related to weapons of mass destruction. As suggested by the title of the legislation, the primary concern was containment of the nuclear threat, although concerns over biological and chemical agents also were to be addressed.[1]

The U.S. Department of Defense (DOD) developed the Cooperative Threat Reduction (CTR) program to implement the Nunn-Lugar legislation, and the CTR program soon involved many organizations in both the United States and the four target countries of Russia, Ukraine, Belarus, and Kazakstan.

In the meantime, the National Research Council (NRC) had taken an active role in helping mobilize support in the United States for international programs

[1] Nuclear, chemical, and biological weapons are grouped together as weapons of mass destruction, but in fact the effects of the three types of weapons vary widely, with nuclear weapons in a class by themselves in terms of the swiftness and sheer magnitude of destruction they would cause. Also, the difficulties associated with designing, producing, and delivering the three types of weapons vary substantially.

that would assist in preserving the base of important research activities in the states to help contain nuclear and other dangerous materials and technologies in the former Soviet Union accept financial offers for transferring weapons know-how to nations of proliferation concern.[2] In addition, in 1992 the National Academy of Sciences (NAS) launched a study of alternative approaches for disposing of plutonium stocks, which were rapidly increasing with the dismantlement of weapons in the United States and Russia pursuant to reductions called for in arms control agreements.[3] Recognizing these and other capabilities of the NRC and its associated institutions, in mid-1993 the Defense Subcommittee of the Appropriations Committee of the U.S. House of Representatives recommended that DOD engage the NRC to examine the implementation of the Nunn-Lugar initiative.

As a result, in the spring of 1995, the Office of the Secretary of Defense requested that the NRC undertake an assessment of the effectiveness of CTR programs to support the efforts of the four countries in the fields of (a) export control, including control of dual-use technologies, and (b) nuclear materials protection, control, and accountability (MPC&A).

This assessment was carried out in parallel with another NRC study of the effectiveness of the early activities of the International Science and Technology Center in Moscow, which the Office of the Secretary of Defense had also requested in the spring of 1995. An NRC publication, *Assessment of the International Science and Technology Center*, presents the findings and conclusions of that study.[4]

DOD provided financial support for this study from funds it had available under the CTR program. However, from the outset of the CTR program, the U.S. Department of Energy (DOE) has been the lead agency for MPC&A activities and the U.S. Department of State has coordinated government-wide export control activities; funds for these efforts were appropriated to DOD and then transferred to the other departments. Beginning in fiscal year 1996, funds for MPC&A

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[2] See National Research Council, *Reorienting the Research Capability of the Former Soviet Union: A Report to the Assistant to the President for Science and Technology* (Washington, D.C.: National Academy Press, 1992), and National Research Council, Committee on Enterprise Management in a Market Economy Under Defense Conversion, *Redeploying Assets of the Russian Defense Sector to the Civilian Economy* (Washington, D.C.: National Academy Press, 1993).

[3] National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium* (Washington, D.C.: National Academy Press, 1994).

[4] The United States, in cooperation with the European Union, Japan, and Russia, established this center in 1994 as a mechanism for providing financial support to former Soviet weapons specialists to enable them to work on civilian-oriented projects rather than be tempted by economic opportunities to transfer their weapons know-how to states of proliferation concern. For additional details, see National Research Council, Committee for the Evaluation of the International Science and Technology Center, *Assessment of the International Science and Technology Center* (Washington, D.C.: National Academy Press, 1996).

and export control activities were included, respectively, in the budgets of the Departments of Energy and State.

With the strong support of all concerned agencies, the present study has addressed a broad range of relevant U.S. Government efforts, regardless of funding sources. The assessment of MPC&A cooperation has concentrated primarily on the activities of DOE, but it has also taken into account the roles of the U.S. Nuclear Regulatory Commission and DOD. The assessment of export control cooperation has included consideration of many activities of the U.S. Department of Commerce, particularly its special role with regard to dual-use technologies; the programs of DOE, with emphasis on nuclear-related controls; the activities of the U.S. Customs Service and State Department; and the supporting efforts of DOD.

Looking to the future, the sources of funding for these activities are important; and the study offers suggestions concerning future funding approaches.

TIME PERIOD OF INTEREST

As noted above, the legislation authorizing the CTR program was originally enacted in the fall of 1991, and DOD began funding program activities shortly thereafter. From the beginning, the executive branch considered MPC&A and export control to be important aspects of the program, and limited efforts in these two fields began in 1992. However, it was not until 1994 that major U.S. investments in MPC&A cooperation began. Similarly, the cooperative program in export control began slowly and gradually increased in size and scope; even now many activities are still in their early stages. Thus, the U.S. agencies anticipate continued involvement with these new programs for at least the next several years and perhaps longer.

While the study takes note of the earliest activities of the U.S. Government in the two program areas, principal attention is given to accomplishments during 1995 and the first half of 1996. As to the future, the study assumes that until the end of the century or longer the U.S. and counterpart governments will show considerable interest in pursuing bilateral programs that help reduce the likelihood of proliferation of nuclear, chemical, and biological weapons; enhance the stature of the countries of the region as responsible international trading partners; and prevent theft and smuggling of items of concern. Thus, the recommendations are directed to actions that should be taken promptly, but they recognize that implementation may take several years or even longer.

RELATED EFFORTS OF THE ACADEMY COMPLEX

In addition to the aforementioned reports on the science centers and plutonium disposition, the NRC has undertaken a number of studies in recent years

that provide important background for the assessment of MPC&A and export controls addressed in the present study.

First, with regard to MPC&A, in 1989 the NRC published the results of an analysis of material control and accounting in the DOE complex and made a number of recommendations for improving the security of nuclear material in the complex.[5] In the study of the disposition of plutonium, special attention was given to the problems of ensuring safe and secure handling of plutonium from the dismantling of warheads through interim storage of excess materials to their ultimate disposition.[6]

In the area of export control the NRC has carried out four studies of U.S. policies during the past two decades. Each considered the balance of economic and national security interests in establishing trade policies. Each also addressed the role of the former Consultative Group and Coordinating Committee for Multilateral Export Controls (COCOM) and consequently gave considerable attention to trade involving the states of the FSU. These studies recognized the importance of controlling the diffusion of sensitive technologies to Third World countries, although proliferation of weapons of mass destruction was not the focus of the studies.[7]

The NRC has also sponsored many studies addressing how emerging technologies can support both economic interests and national security objectives. Most recently, it has carried out studies of the opportunities for DOD to utilize commercially available technologies to satisfy military requirements in selected fields.[8] An earlier NRC study explicitly addressed the export control dimensions of new computer technologies.[9] Also, a study carried out jointly with the Russian

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[5] National Research Council, Energy Engineering Board, *Material Control and Accounting in the Department of Energy's Nuclear Fuel Complex* (Washington, D.C.: National Academy Press, 1989).

[6] *Management and Disposition,* op. cit.

[7] National Research Council, Panel on Scientific Communication and National Security, *Scientific Communication and National Security: A Report* (Washington, D.C.: National Academy Press, 1982); National Research Council, Academy Industry Program, *Export Controls: Reconciling National Objectives* (Washington, D.C.: National Academy Press, 1984); National Research Council, Panel on the Impact of National Security Controls on International Technology Transfer, *Balancing the National Interest: U.S. National Security Export Controls and Global Economic Competition* (Washington, D.C.: National Academy Press, 1987); National Research Council, Panel on the Future Design and Implementation of U.S. National Security Export Controls, *Finding Common Ground: U.S. Export Controls in a Changed Global Environment* (Washington, D.C.: National Academy Press, 1991).

[8] National Research Council, Committee on Defense Manufacturing Strategy, *Breaking the Mold: Forging a Common Defense Manufacturing Vision* (Washington, D.C.: National Academy Press, 1993).

[9] National Research Council, Committee to Study International Developments in Computer Science and Technology, *Global Trends in Computer Technology and Their Impact on Export Control* (Washington, D.C.: National Academy Press, 1988).

[10] National Research Council, Committee on Dual-Use Technologies, *Dual-Use Technologies and Export Control in the Post-Cold War Era: Documents from a Joint Program of the National Academy of Sciences and the Russian Academy of Sciences* (Washington, D.C.: National Academy Press, 1994).

Academy of Sciences considered confidence-building steps that would encourage restraint in the development and deployment of weapons of mass destruction.[10]

The NRC also has a standing committee that provides advice to the U.S. Government on methods for destruction of chemical weapons stockpiles. With regard to biological weapons, NAS has a working group on controlling such weapons that has carried out many discussions with Russian counterparts on nonproliferation measures.[11]

RELATED STUDIES BY OTHER ORGANIZATIONS

During the past several years, many U.S. congressional hearings, U.S. executive branch assessments, national and international conferences, and academic studies have been directed to proliferation problems that have roots in the FSU and the responses of the U.S. Government to these problems. A number of these analytical efforts have emphasized the importance of controlling nuclear material in Russia. Less attention has been given to nuclear-related issues in the other former Soviet states. The development of export control systems to help contain items of proliferation concern and the contribution of American specialists in this process have received only limited attention.[12]

The writings that emerged from these earlier efforts repeatedly underscored the serious inadequacies in protection of plutonium and highly enriched uranium throughout the nuclear complex of the FSU. Also, the reports emphasized the urgency of financing and launching American programs, in cooperation with counterpart organizations, that will lead to better containment of fissile material that is directly usable in nuclear weapons. They highlight the many administrative difficulties, particularly in Russia, that have inhibited faster implementation of bilateral programs. The most recent reports, however, note that many of these administrative barriers have been overcome and that the programs are now moving ahead more easily.[13]

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[11] The Committee on the Review and Evaluation of the Army Chemical Stockpile Disposal Program was created under the NRC Commission on Engineering and Technical Systems in 1987, and the Working Group on Biological Weapons was established under the NAS Committee on International Security and Arms Control in 1986.

[12] For an early exception, see Gary Bertsch and Igor Khripunov, "Nonproliferation and Export Control in the Former Soviet Union," *Eye on Supply*, no. 8, Winter 1993, p. 75.

[13] See, for example, G. Allison, O. Cote, Jr., R. Falkenrath, and S. Miller, *Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material* (Cambridge, Mass.: MIT Press, 1996), pp. 118-145, and testimonies of government officials and independent experts before the Permanent Subcommittee on Investigation of the Senate Committee on Government Affairs, March 20, 1996.

Less research and documentation address export control issues. Most understand the need to control nuclear and other dangerous materials and technologies, and they conclude that, in view of the extensive and often remote borders of the countries of the region, enforcement of export controls will indeed be a difficult task.[14]

In short, the previous studies provide a very useful, albeit incomplete, background of evidence and analysis of the seriousness of the problems being addressed by the cooperative programs in the fields of export control and MPC&A.[15] However, they have not addressed in detail the effectiveness of U.S. cooperative programs, lessons learned from these programs, or steps that can be taken to increase the impact of the programs. This study seeks to fill those gaps.

ROLE OF THE NRC COMMITTEE FOR THIS STUDY

During the summer of 1995, the chairman of the NRC appointed a 10-member interdisciplinary committee of specialists to carry out this study. The charge to the committee is set out in Appendix C. Biographies of committee members are attached as Appendix D.

In preparation for the committee's work, the project staff held discussions with governmental and nongovernmental specialists in the field. Many of these specialists were invited to meet with the committee. Moreover, early in the study many members of the committee participated in special briefings on developments in the FSU organized at several government agencies in Washington and at Los Alamos and Sandia National Laboratories. Also, the staff compiled an extensive collection of relevant documents prepared by American and foreign organizations that provided important background for the committee's meetings. All documents used in preparing this report were unclassified, although selected committee members and staff had the benefit of several classified briefings.

During the first half of 1996, committee members traveled to Russia, Ukraine, Belarus, and Kazakstan to gain firsthand impressions of developments in these

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[14] See, for example, "Export Controls in the New Independent States," *Proceedings of the International Workshop* (Minsk: Eridan, 1995); Mikhail Ustyugov, "Problems of Developing an Export Control System in Kazakstan," and Gary Bertsch, "Controlling the Spread of the Soviet Arsenal," *The Monitor: Nonproliferation, Demilitarization, and Arms Control*, vol. 2, Winter/Spring 1996, pp. 8-10 and 33-39; and Gary Bertsch and Igor Khripunov, eds., *Russia's Nonproliferation and Conventional Weapons Export Controls: 1995 Annual Report* (Athens: University of Georgia, 1996).

[15] These studies have involved and been published by many American nongovernmental organizations. Those that have been particularly interested in export control and/or MPC&A issues in the FSU include the Center of International Trade and Security, University of Georgia; John F. Kennedy School of Government, Harvard University; Natural Resources Defense Council; Lawyers Alliance for World Security; Monterey Institute of International Studies; and Carnegie Endowment for International Peace.

countries, particularly the impact of American programs of interest to the committee. The trips included consultations with local and American officials and specialists and visits to facilities that were of special relevance to U.S. efforts in the countries. Also, in Moscow small seminars were held with Russian specialists concerning (a) dual-use technologies currently in the development phase and (b) the interests of Russian industrialists with regard to the evolution of export controls in Russia.

In addition to the meetings in Washington, D.C. and New Mexico, the committee spent one week in July 1996 at the conference site of the National Academy of Sciences in Woods Hole, Massachusetts, to develop the framework for this report. The committee recognized the difficulties of writing a report on programs that are still unfolding in a region in flux and decided to concentrate on developments that took place prior to the summer of 1996. After the report had been reviewed according to NRC procedures, the committee approved the final draft in February 1997, cognizant of many recent events that were not adequately reflected in the report but nevertheless confident that the overall thrust of the report remained valid.

Throughout the entire process, many officials and other specialists in the United States and the FSU took time to provide very important information and insights for the committee. The Departments of Defense, State, Energy, and Commerce, the U.S. Customs Service, and the American embassies in Moscow, Kiev, Minsk, and Almaty were extraordinarily helpful in arranging visits and consultations for the committee. Appendix B identifies the formal meetings and visits. Of no less significance were the many informal discussions also arranged through numerous channels in the United States and abroad.

The committee expresses its appreciation to the many individuals and institutions in the United States and abroad who assisted its efforts. It also is grateful for the exceptional assistance of the NRC staff. Any errors in this report are the committee's own.

RICHARD A. MESERVE, Chairman, Committee on Dual-Use Technologies, Export Control, and Materials Protection, Control, and Accountability

Executive Summary

The successor states of the former Soviet Union (FSU), particularly Russia, have enormous stocks of weapons-usable nuclear material and other militarily significant commodities and technologies. Preventing the flow of such items to countries of proliferation concern and to terrorist groups is a major objective of U.S. national security policy.

Russian officials have acknowledged two dozen incidents of thefts and attempted thefts of nuclear-related items in Russian facilities, including several cases involving small quantities of fissile material. Such incidents support U.S. Government assessments that, as a result of the dissolution of the Soviet Union, nuclear weapons technologies are now more accessible to nations and subnational groups seeking to acquire such weaponry than at any other time in history.

Missile components traceable to the FSU have been intercepted in Jordan en route to Iraq. Also, the *Aum Shinrikyo* cult, which released sarin gas in the Tokyo subway in 1995, obtained a helicopter and other support equipment from Russia, presumably for use in related activities.

Other than such anecdotal evidence, reliable information is not available about the quantities and types of sensitive commodities leaving the FSU—as items of trade or as contraband. But the stakes are so great that it is only prudent to assume that significant transfers of sensitive items are a serious possibility.

This study reviews the effectiveness of U.S. bilateral programs initiated in the early 1990s to support the efforts of Russia, Ukraine, Kazakstan, and Belarus in strengthening two important mechanisms for controlling the diffusion of militarily sensitive items, namely:

- systems for materials protection, control, and accountability (MPC&A) of highly enriched uranium and plutonium, which emphasized improved safeguards approaches at the facility level, and
- export control systems covering many types of sensitive items, including dual-use items, with the programs having given primary attention to regulatory and enforcement capabilities at the national level.

Russia, Ukraine, Belarus, and Kazakstan are the focus of this effort because almost all of the fissile material of concern and the bulk of other militarily sensitive items arising from the days of the Soviet Union are found in these countries. Also, these countries were singled out for a range of U.S. cooperative security efforts in the FSU in view of the past deployment of nuclear weapons on their territories.

CHALLENGES IN CONTROLLING MILITARILY SENSITIVE ITEMS

Containment of "Direct-Use" Material

This study addresses efforts to upgrade the security of stocks of unirradiated uranium enriched to a level of 20 percent or greater (referred to herein as highly enriched uranium or HEU) and of separated plutonium of weapons grade or reactor grade (referred to herein as plutonium). HEU and plutonium are suitable for use in constructing a nuclear weapon without further enrichment or chemical reprocessing; they are thus called direct-use material. Such material is located in hundreds of buildings at widely dispersed sites; most are in Russia, but a few are in Ukraine, Belarus, and Kazakstan.

The study considered various bilateral programs involving U.S. specialists directed to the protection of HEU and plutonium, particularly those managed on the U.S. side by the Department of Energy (DOE). It did not address programs of the U.S. Department of Defense (DOD) concerning direct-use material in weapons or in other forms under the control of the Russian Ministry of Defense. The study did examine DOE efforts to address the security of nuclear fuel of the Russian Navy and civilian icebreaker fleet.

The difficulty in obtaining direct-use material is a principal technical barrier preventing countries of proliferation concern, as well as subnational groups, from acquiring a nuclear weapons capability. Many other components are required to construct a nuclear weapon, but most probably can be more readily obtained than direct-use material. Efforts to prevent wide diffusion of all critical items needed for nuclear weapons have of course been pursued by the United States.

Several kilograms of plutonium or several times that amount of HEU are required to construct a nuclear weapon, with the quantity depending on the composition of the material, type of weapon, and sophistication of the design. Details

aside, the necessary amounts are very small compared to the many hundreds of tons of nuclear materials in the FSU, with uncertain and, in some cases, inadequate security arrangements. Most of the material is HEU, which is of particular concern. HEU can be used in weapons of primitive design and is more readily concealed during transport than plutonium since its radiation signature is easier to shield.

Given the small quantities of direct-use material required for nuclear weapons, the first challenge is to ensure that *all* such material is brought under effective MPC&A systems. Then the systems must have the integrity to ensure that materials are used only in an authorized manner.

Controlling Exports of Sensitive Items

Effective regulatory systems for controlling exports of many types of sensitive commodities and technologies from the Soviet successor states to questionable destinations also are of critical importance. The second focal point of this study is therefore the set of bilateral programs directed to improving systems for controlling exports of such items from Russia, Ukraine, Belarus, and Kazakstan.

Hundreds of enterprises and institutes developed and produced sensitive commodities in the four countries. A large number of these facilities, as well as dozens of warehouse and trading organizations, have old and new inventories of sensitive materials and equipment and also possess technical design information. The economic pressures to sell these items are intense.

National systems should effectively control exports of sensitive commodities and technical data, in accordance with international norms that recognize the importance of both nonproliferation goals and legitimate trade. Of special concern are international transfers of controlled items to inappropriate end users by (a) smugglers and (b) enterprises or trading organizations that violate national export control requirements.

While providing important guidance for regulating exports of many items, the existing international agreements on export control call for prohibitions or restrictions on transfers of only the most critical items. These agreements emphasize the need for transparency of international transfers rather than limitations on exports of most weapons-related items and dual-use commodities; for these items, each government, though required to establish an export licensing system, retains the prerogative to decide when an export is appropriate. Thus, if diffusion of sensitive items to countries of proliferation concern and terrorist groups is to be contained on a broad basis, the governments of Russia and the other successor states must be committed not only to establishing internationally acceptable export control machinery, but also to achieving nonproliferation goals in their national decisions on specific exports of militarily significant items.

Of special note, Russia inherited a large storehouse of facilities, equipment, and technology related to biological and chemical warfare; and many of these

items should be carefully controlled. While the U.S. Government has undertaken efforts to help contain nuclear and other dangerous materials and technologies in the Former Soviet Union the scope of this study.

U.S. RESPONSE FOR SECURING SENSITIVE ITEMS IN RUSSIA, UKRAINE, BELARUS, AND KAZAKSTAN

The U.S. Policy Context

The International Export Control Regimes

For a number of years the United States, in concert with its traditional allies, has taken a variety of steps to reduce the likelihood that militarily sensitive items would move freely in international commerce. Central to this effort has been strong support for the establishment and operation of international control regimes covering exports of selected commodities and related technical information in the following areas: nuclear, chemical, biological, and advanced conventional weapons systems; missile systems; and other strategic items with both military and civilian applications. The regimes also cover the technologies needed to design or manufacture commodities in the foregoing categories.

These regimes provide a very important framework for the establishment of national export control systems. They require licensing of all items that have been identified as being of concern to the international community. Therefore, they greatly complicate the efforts of states of proliferation concern or terrorist groups in obtaining access to sensitive materials, equipment, or technical data. Table 1.1 identifies the international control regimes.

These regimes have established approaches for addressing export controls that have become the norms in the free market economies. Thus, even though the four countries are not members of some of the regimes, they appreciate the need to adopt similar practices if they are to be recognized as responsible trading partners.

Bilateral Activities

The United States has established bilateral programs with each of the four successor states to help prevent the diffusion of sensitive material and equipment, particularly direct-use nuclear material. Through such programs the U.S. Government has encouraged the key industrial countries of the region to conform as soon as possible to the requirements of the international regimes. Also, the United States has mounted diplomatic efforts to discourage proposed sales of certain sensitive items, even though such sales are not prohibited by the regimes (e.g., the Russian sale of nuclear reactor components to Iran).

The MPC&A programs that are the focal points of this study are carried out

TABLE 1.1 Participation in International Control Regimes

	Regime[a]	Russia	Ukraine	Belarus	Kazakstan
Nuclear	Non-Proliferation Treaty (NPT)	Ratified in 1970 (NWS)[b]	Ratified in 1994 (NNWS)[c]	Ratified in 1993 (NNWS)[b]	Ratified in 1994 (NNWS)
	NPT Exporters Committee (Zangger Committee)	Member since 1971			
	Nuclear Suppliers Group (NSG)	Member since 1974	Member since 1996		
Biological	Biological Weapons Convention	Ratified in 1975	Ratified in 1975[d]	Ratified in 1975[d]	
	Australia Group (Biological and Chemical)	Has stated that its controls are consistent with requirements	Has stated that its controls are consistent with requirements		
Chemical	Chemical Weapons Convention	Signed in 1993	Signed in 1993	Ratified in 1996	Signed in 1993
Missile	Missile Technology Control Regime (MTCR)	Member since 1995	Adherent since 1994		
Dual-Use Technologies	Wassenaar Arrangement	Member since 1996	Member since 1996		
Conventional Weapons					

[a]See Appendix A for a discussion of the international control regimes.
[b]Nuclear Weapons State (NWS) Party: Under the NPT, states that detonated a nuclear explosion prior to January 1, 1967, are classified as nuclear weapons states. They are permitted to retain nuclear weapons and are not required to accept comprehensive International Atomic Energy Agency (IAEA) inspections of their nuclear activities.
[c]Non-Nuclear Weapons States (NNWS) Party: These states are prohibited by the NPT from manufacturing or possessing nuclear weapons and are required to accept IAEA inspections of all nuclear activities.
[d]The Ukrainian and Belorussian soviet socialist republics each ratified the convention.

Source: U.S. Department of State.

in the broader context of a large number of programs supported by the U.S. Government to help contain nuclear and other dangerous materials and technologies in the former Soviet Union rial stockpiles through American purchases of stocks of HEU from Kazakstan and Russia, assessing the feasibility of terminating production of plutonium in nuclear reactors in Tomsk-7 and Krasnoyarsk-26, supporting cooperative projects that encourage civilian production activities at weapons-oriented enterprises, and providing economic incentives for FSU weapons scientists and engineers to redirect their efforts to peaceful pursuits rather than be tempted to look abroad for customers for their weapons know-how.

Bilateral Cooperation in Containment of Direct-Use Material and Export Control

While some of the foregoing activities moved forward on a cooperative basis in the period from 1992 to 1994, the U.S. Government had considerable difficulty establishing significant cooperative programs in MPC&A and export control, despite the availability of a mandate and funding from the U.S. Congress. Nonetheless, during this period, American experts from both the public and the private sectors took advantage of limited opportunities to acquaint officials of the region with western approaches in both fields.

In time, administrative and political problems in the FSU and in Washington diminished. Since the beginning of 1995 a number of U.S. Government agencies have undertaken sizable bilateral programs directed at MPC&A and export control. Tables 1.2 and 1.3 summarize the activities under U.S. Government programs to date.

The characteristics of the two programs are very different. MPC&A systems concentrate on a single item—direct-use nuclear material. They limit access to areas where material is located and provide for strict control and accountability of the material. The types and locations of the facilities of interest are generally well known. The systems are designed to prevent theft or diversion of direct-use material at the facility level and in transit between facilities and, when such prevention fails, the prompt detection of missing material. Table 1.4 presents the key elements of an MPC&A system.

Export control activities, by contrast, embrace many different types of materials, equipment, and technical data. They include establishment of a legal framework, a licensing procedure, enforcement mechanisms with programs for detecting and prosecuting violators of export control laws and regulations, and programs to inform exporters of their obligations. The numbers of interested government agencies and affected facilities are very large. Table 1.5 presents the elements of an export control system as set forth in the "Common Standard" developed by the former Consultative Group and Coordinating Committee for Multilateral Export Controls (COCOM). This Standard has been widely accepted by western governments.

Within these two programs the U.S. agencies measure progress toward the

TABLE 1.2 MPC&A Program Activities in the FSU Supported by DOE (as of June 1996)

Russia	*Government-to-Government:* Activities at eleven MINATOM sites (two fuel fabrication plants, one breeder reactor, three reactor technology institutes, five research institutes); support for Obninsk Training Center *Agreement with GAN:* Regulatory document development; MC&A information system; MC&A equipment; Activities at six non-MINATOM sites *Laboratory-to-Laboratory:* Activities at eight MINATOM sites (three plutonium sites, three uranium enrichment sites, two nuclear weapons labs, one research and development institute); Activities at Kurchatov; Activities at two naval fuel storage facilities (Northern and Pacific fleets) and the icebreaker fleet; transportation security
Belarus	Activities at one site (research institute)
Kazakstan	Activities at four sites (one low-enriched uranium fuel fabrication plant, one power-breeder reactor, two research institutes)
Ukraine	Activities at four sites (one power reactor complex, three research institutes)
Uzbekistan	Activities at one site (research institute)
Latvia	Activities at one site (research institute)
Lithuania	Activities at one site (power reactor complex)
Georgia	Activities at one site (research institute)

Source: U.S. Department of Energy.

TABLE 1.3 U.S. Export Control Program Activities Involving Russia, Ukraine, Belarus, and Kazakstan supported by the U.S. Departments of State, Commerce, Energy, and Defense, and the U.S. Customs Service

Policy-level exchanges to emphasize the importance of enactment and enforcement of export control legislation
Training on the essential elements of comprehensive export control laws and enforcement regulations (except Russia)
Computer automation of export control licensing procedures and provision of enforcement equipment (except Russia)
Workshops on international nonproliferation export control regimes and associated control lists
Seminars on government outreach to nongovernmental entities and manufacturing organizations on export control and nonproliferation
Training and equipment for supporting enforcement activities
Lab-to-lab programs, including technical exchanges, directed to nuclear-related exports

Source: U.S. Departments of State, Commerce, and Energy.

TABLE 1.4 Components of an MPC&A System

	Physical Protection	Control	Accounting
Detection and assessment (sensors, alarms, and assessment systems such as video)	X	X	
Delay (barriers, locks, traps, booths, active measures)	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		
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

Sources: NRC committee and publications of the U.S. Department of Energy.

goal of nonproliferation by (a) the amount of direct-use material contained in secure MPC&A systems and (b) the extent to which functioning export control regulatory systems, including enforcement mechanisms, have been established. The agencies are well aware that such measures do not indicate the seriousness of the remaining vulnerabilities in the systems nor do they reflect the more limited progress that would be achieved without U.S. involvement. Still, the agencies recognize their usefulness as indicators of the scope of the programs and of program accomplishments.

FINDINGS AND RECOMMENDATIONS TO THE U.S. GOVERNMENT CONCERNING COOPERATION IN MPC&A

The committee considered but did not use structured criteria for evaluating the effectiveness of the cooperative programs. Both the joint efforts and the

TABLE 1.5 Common Standard for Export Control (The Common Standard Level of Effective Protection, Developed by COCOM)

Prelicensing Requirements

Adequate manpower and equipment available to the licensing authorities
Lists of controlled products published nationally
Legal and regulatory bases for controls with sanctions for violations
Awareness by industry of the objective of controls
Specification of information required on license applications
System of import and delivery verification certificates and end-use statements
Capability to review license requests and to evaluate parties to transactions, specifications of products to be exported, and any inherent risks

Postlicensing Requirements

Legislation should include provisions enabling national authorities to

- deter, prevent, and punish illegal exporters;
- carry out checks after licenses are issued; and
- monitor licensed exports (inspect goods, seize suspect shipments, apply sanctions).

At the enforcement level, national authorities should provide

- necessary financial and other resources;
- adequate training of personnel; and
- support for development of a capability to compile, assess, and distribute relevant information and to take into account all available sources of information.

Source: U.S. Department of Commerce.

related activities of the governments and at the facilities are evolving rapidly. Thus, progress attributable to cooperation is not quantifiable. Also, the optimum upgrade programs against which to judge the impacts of U.S. efforts cannot be easily framed, given the political and economic uncertainties in the four successor countries and our incomplete knowledge of the status of Russian facilities. Therefore, the committee's judgments are largely qualitative in nature and are intended to provide an overall sense of the impact of cooperation.

General Findings

After initial delays of more than two years due primarily to a lack of interest in Moscow in cooperative arrangements that the United States considered equitable and essential, progress attributable to the joint efforts of U.S. and Russian specialists in MPC&A greatly accelerated in 1995 and 1996. DOE estimates that U.S. specialists have gained access to some of the many buildings at approximately 90 percent of the sites where direct-use material is known to be located outside the Russian Ministry of Defense complex and have initiated cooperative interactions to address many of the most pressing MPC&A issues at these sites.

This is a significant political and organizational achievement, considering (a) the Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union had relied primarily on controlling people, to an approach that increasingly relies on technical measures and (b) the history of secrecy throughout the Soviet nuclear complex. But while improvements have been made at selected facilities, the task has not been completed at any Russian facility and serious efforts are only beginning at most facilities. DOE estimates that *tons* of direct-use material are contained in internationally acceptable MPC&A systems and that *tens of tons* are in partially acceptable systems, but adequate MPC&A systems for *hundreds of tons* must still be installed. Thus, the challenge now is to extend the organizational and political achievements to significant technical improvements, a process that is only beginning.

In Ukraine, Belarus, and Kazakstan, cooperative efforts have already achieved easily discernible technical improvements. Of special interest, DOE announced in 1996 that it had completed MPC&A upgrades at the Institute of Nuclear Power Engineering in Belarus, the only known facility in Belarus with direct-use material.

Several other accomplishments for which the United States can take considerable credit illustrate the importance of the program to date. Building 116 at the Kurchatov Institute of Atomic Energy in Moscow and a building at Arzamas-16 have become MPC&A models, attracting the attention of hundreds of Russian officials and specialists responsible for MPC&A programs. The Russian Ministry of Atomic Energy is using the MPC&A training center at Obninsk as the focal point for upgrading the skills of specialists from throughout the country. American specialists have successfully taken the first steps in initiating cooperative programs with Russian specialists from naval reactor fuel storage facilities and from highly sensitive nuclear weapons assembly and dismantlement facilities. In Kazakstan, the government has committed to installing complete MPC&A systems at its nuclear facilities as quickly as possible. In Ukraine, American specialists have been given access to a previously closed facility at the Sevastopol naval base, while upgrade activities proceed at the two other principal nuclear facilities.

Nevertheless, the size of the Soviet nuclear complex was enormous, and much remains to be done. The need for American specialists to continue to support upgrading of MPC&A systems until such time as the institutions in all four successor countries are willing and able to continue on their own is very clear. Even in Belarus, where all upgrades are in place, visits by American specialists are important to ensure that they are maintained as designed.

Having overcome significant political, cultural, and organizational hurdles, and in the absence of dramatic political change, the cooperative program should be in position to make significant progress over the next several years. As the program moves into the next stage of rapid implementation, certain overarching principles should guide cooperative efforts.

• For the near term it is essential that the United States *sustain* its involvement in the cooperative efforts to help contain nuclear and other dangerous materials and technologies in the FSU, including upgrading and maintaining MPC&A programs over the long term.

• Emphasis should be on upgrading the skills of specialists in the four countries, relying on local expertise and whenever possible local equipment, and establishing viable long-term funding sources—in short, actions to *indigenize* the implementation activities.

• Drawing on cooperative efforts to date, the governments and institutions in the FSU should *simplify* the problem by reducing the direct-use material of concern and consolidating the remaining material at fewer sites and fewer locations within sites.

• The cooperative programs should include more concerted efforts to *minimize the possible routes to bypass* the MPC&A systems.

• The participating specialists should *enhance the program* in several areas to increase the effectiveness of their joint efforts.

I. Sustain the U.S. Commitment to the Program

Finding: The continued flow of U.S. funds in the near term is essential because of the limited ability of the four governments to finance MPC&A upgrades. The next few years will be a critical period for upgrading systems to an acceptable level, and U.S. specialists are in a unique position to help ensure that such upgrades are given high priority and installed in a prompt and effective manner. The current level of U.S. funding of MPC&A programs is about $100 million annually.

Recommendation: Continue to fund MPC&A efforts in the FSU at least at the level of fiscal year 1996 for several more years and be prepared to increase funding should particularly important high-impact opportunities arise.

II. Indigenize MPC&A Capabilities

Finding: Once the U.S. program ends, the cooperating governments must be committed and able to assume full responsibility for funding and maintaining upgraded MPC&A systems. The challenge is great, as economic shortfalls even for basic program support limit the domestic funds available for MPC&A. Nevertheless, ministries, institutes, and individuals must be prepared to implement adequate MPC&A programs and have access to income streams that will permit them to continue their efforts in the long term.

Recommendation: Continue to emphasize the importance of MPC&A as a nonproliferation imperative at the highest political levels in the FSU.

Recommendation: 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 to stimulate long-term commitments.

Recommendation: Involve institute personnel to the fullest extent possible in determining how to use available funds for upgrades.

Recommendation: Give greater emphasis to near-term training of local specialists.

Recommendation: 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.

Recommendation: 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 HEU.

Recommendation: Rely increasingly on domestically produced and locally available equipment for physical protection, detection, analysis, and related MPC&A tasks.

III. Simplify the Problem

Finding: The challenge of controlling small amounts of direct-use material located in hundreds of buildings, including many in a poor state of repair, seems overwhelming. If the amount of material and the number of storage areas could be substantially reduced, the time and costs involved in installing MPC&A systems also could be significantly reduced.

As for Russia, the previously noted U.S. programs concerning purchase of HEU and alternative energy sources for the plutonium production reactors at Krasnoyarsk-26 and Tomsk-7 are directed to reducing the amount of direct-use material in the country. Very limited discussions have addressed the other large source of plutonium production—the nuclear fuel rod reprocessing plant at the Mayak complex. The Russian Government has shown no interest in terminating this activity. A remaining challenge is consolidation of material.

Outside Russia, the future use of the small remaining stocks of direct-use material is uncertain at best. Retaining these stocks requires significant MPC&A expenditures and continued vigilance over the possibility of theft.

Recommendation: In Russia, encourage consolidation of direct-use material in fewer buildings, at fewer facilities, and at fewer sites.

Recommendation: Take steps to encourage the removal of all HEU at research facilities outside Russia, including the purchase of HEU when appropriate.

Recommendation: For research reactors outside Russia where important and adequately financed research programs are planned in the foreseeable future, support conversion of the reactors so that they can use low-enriched uranium instead of HEU.

IV. Minimize the Possibilities To Bypass MPC&A Systems

Specific Finding: If an MPC&A program is to be effective, all relevant organizations and all sources of direct-use material must be addressed. Of special concern, large stocks of direct-use material are located at some Russian facilities that have not yet become active participants in the bilateral program.

However, as facilities become involved in the program, there is uncertainty among both Russian and American specialists as to the precise amounts of direct-use material present. For example, at some facilities there was a practice of maintaining stocks of material "off the books," and at these and other facilities the inventory records may be unreliable. Previous control systems may not have given sufficient attention to scrap and off-specification material. Also, during a period of political and economic turmoil and expanded criminal activities, the possibility of efforts by irresponsible persons to remove material from the MPC&A systems while the systems are being evaluated for upgrades or even after such systems are in place cannot be ignored.

An important oversight agency in Russia, the State Nuclear Regulatory Committee, Gosatomnadzor (GAN), suffers from a shortage of well-trained inspectors, qualified staff, and necessary analytical and related equipment, as well as uncertain administrative responsibility with regard to military-related activities.

Recommendation: Ensure that all stocks of direct-use material are encompassed in the program, including icebreaker nuclear fuel, supplies at naval facilities, and off-specification and scrap material.

Recommendation: Encourage rapid development of a comprehensive national material control and accounting system in Russia and the prompt incorporation of all existing direct-use material into that system.

Recommendation: In Russia, increase support of GAN as an important independent agency by assisting it in developing MPC&A methodologies, training inspectors, obtaining staff support from research institutions, and procuring necessary equipment for MPC&A inspections.

Recommendation: Encourage a system of incentives, possibly including financial rewards, that will motivate participants in MPC&A programs to report promptly to central authorities any irregularities in the implementation of MPC&A systems.

Recommendation: Emphasize the importance of developing a culture among MPC&A specialists that does not tolerate shortcuts or exceptions in implementing MPC&A systems.

V. Enhance the Program

Finding: A number of initiatives will enhance the effectiveness of U.S. efforts.

The threats of theft and diversion in the FSU differ significantly from those in the United States. The general economic and crime situation in the FSU raises the prospect of different threat scenarios than in the United States. Moreover, there are differences in the facilities that affect susceptibility to the loss of material. In the FSU, many buildings where direct-use material is stored are in poor repair, long perimeters with inadequate protection characterize some sites where material is located, and old accounting systems of dubious reliability are used at some facilities. Some local specialists are not prepared to absorb sophisticated technologies. Modest immediate enhancements at a large number of facilities may be more important than major investments at a limited number of storage locations.

Another area of concern is the vulnerability of direct-use material during transport—a topic that has not been a priority in past cooperative efforts. Trucks and other vehicles that are not suitable for transporting direct-use material are in use, and the rigor of the accounting systems for tracking the movement of material is of concern.

Also, the continued isolation of some facilities where MPC&A upgrades are needed limits the opportunities for specialists at one facility to learn from the experiences of their colleagues at other facilities.

Finally, several agencies are usually involved in providing security for direct-use material, including responding to incidents and alarms. In Russia, the Ministry of Interior and the Federal Intelligence Service do not appear to be adequately involved in designing MPC&A upgrades, a task left largely to specialists of the Ministry for Atomic Energy or of the other concerned research organizations.

Recommendation: Emphasize MPC&A approaches that respond to threat scenarios that are appropriate for the FSU, recognizing that they may differ from the threat scenarios used in the United States.

Recommendation: Recognize that in the near term it may be necessary to install systems that fall short of internationally accepted standards in

anticipation of subsequent refinements. In this regard, use appropriate MPC&A upgrades, whether they involve high-tech or low-tech approaches.

Recommendation: In Russia, give greater attention to MPC&A of direct-use material during transport within and between facilities.

Recommendation: Promote greater communication and cooperation among ministries and facilities involved in MPC&A in each of the countries where bilateral programs are being implemented.

Recommendation: In Russia, encourage more active involvement of the Ministry of Interior in the planning, testing, and implementation of physical security systems.

FINDINGS AND RECOMMENDATIONS TO THE U.S. GOVERNMENT CONCERNING COOPERATION IN EXPORT CONTROL

General Findings

After initial delays of more than two years owing to interagency uncertainties and procurement problems in Washington and to a lack of readiness in the FSU to initiate serious collaboration, U.S. efforts have stimulated interest and action at the policy and technical levels to strengthen export control systems in Russia and to establish new systems in Ukraine, Kazakstan, and Belarus. American specialists and their counterparts have developed a high degree of mutual confidence that their joint efforts are producing important results in critical areas, and enthusiasm of government officials of the four cooperating countries is high for the joint programs. The joint efforts, undertaken at relatively low cost, have been particularly important in developing the legal bases for export control, training cadres of specialists in a variety of relevant fields, and installing systems for more efficient processing and validation of license requests. Despite these early accomplishments, much remains to be done in the development of comprehensive and effective export control systems in the four countries.

Several specific examples illustrate how American involvement has triggered new activities. In Russia, a number of enterprise managers are applying American experience in establishing new internal mechanisms to ensure compliance with regulations. U.S. support has been very important in facilitating the membership and participation of Ukraine in the Nuclear Suppliers Group and the Wassenaar Arrangement. Belarus regulatory authorities and the customs service have used American computer hardware and software in establishing information systems that have greatly enhanced their capabilities to process and track export control cases. In Kazakstan, the insistence of American specialists that presidential decrees and regulations be codified into law has provided the country with a stable legal base for export control that should withstand political shocks.

But American specialists can continue to play an important role—in many requirements of the international control regimes. For example, interagency regulatory mechanisms are in place in each of the four countries, but additional experience is needed to ensure the effective integration of all international control lists into the review processes. Although the customs services have greatly expanded their manpower, training of new personnel remains a priority.

A few areas deserve special emphasis during the next several years.

- Cooperative efforts should reflect the need for the four successor countries to *complete the legal, organizational, and manpower infrastructure* for regulating exports of critical items.
- The importance of the governments continuing to *strengthen implementation and enforcement capabilities* is very clear.
- Since not all aspects of export control can receive immediate attention, priorities should *focus additional efforts on urgent problems*, including (a) the need to control the most sensitive items first, (b) the opportunities for promoting stewardship and internal compliance at the enterprise level, and (c) the importance of participation by adjacent states of the FSU in regional approaches to combat smuggling and unsanctioned transshipments of sensitive items.
- Preventing the diffusion of certain types of technical data can sometimes be more important than containing sensitive commodities, and higher priority should be given to efforts to *control sensitive technical information.*
- An important need is the evolution of a cadre of export control officials who *give adequate weight to proliferation concerns* in their decision making. Governments must not only have regulatory systems that operate in conformity with the procedural requirements of the international regimes but must also reflect a commitment to nonproliferation goals in their export decisions.

I. Support Completion of the Legal, Organizational, and Manpower Infrastructure for Effective Export Control

Specific Finding: A starting point for controlling exports of sensitive items is a legal and organizational structure that provides the capability for policy and regulatory development, licensing activities, and enforcement. Each of the four successor countries is in the process of broadening and codifying the legal basis for its programs and of providing an operational system that is staffed with well-trained specialists. This long-term effort requires continued attention over a number of years. The United States has the most fully developed export control infrastructure in the world and is in a strong position to contribute in many ways. Over the long term, however, the four countries must assume responsibility for ensuring that improvements are sustained.

Budgetary support in the United States for bilateral export control programs

is in constant jeopardy because funding is provided through the relatively small budget of the Department of State. The Congress appropriated $10 million for export control cooperation worldwide, together with other funds already in the pipeline from previous appropriations to DOD, has sustained an adequate level of activity in the FSU, but the reduction of funding to less than $5 million for FY 1997 jeopardizes future progress.

Further confusing the budget situation, the U.S. Customs Service and DOE recently received special appropriations to cover some of their activities in cooperative programs, while the Department of Commerce, which has much to contribute, has no access to special funds.

Recommendation: Continue to fund export control efforts in the FSU at least at the level of FY 1996 for several more years and be prepared to increase funding should particularly important high-impact opportunities arise.

Recommendation: Ensure that adequate resources are available to the Department of Commerce, as well as to the Departments of State, Defense, and Energy and the U.S. Customs Service, so that specialists with unique expertise can continue to participate in the programs.

Recommendation: Emphasize in bilateral discussions at all levels the importance of developing capabilities to meet international requirements for export control and to ensure adherence to all relevant aspects of the international control regimes.

Recommendation: Negotiate an intergovernmental agreement with Russia to help ensure the long-term stability of bilateral cooperation in the field of export control.

Recommendation: Support the strengthening of institutions in the FSU that provide training and advisory services for government agencies and enterprises involved in export control.

Recommendation: Involve interested American universities and nongovernmental organizations, when appropriate, in promoting training and research related to export control that involves specialists from the FSU.

II. Strengthen Implementation and Enforcement Capabilities

Specific Finding: In each of the four successor countries there is a considerable gap between the requirements and plans for export control activities and the implementation of effective programs for fulfilling those requirements, particu-

larly in the area of enforcement. Joint programs have imparted momentum in the Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union
appears that there have been very few successful prosecutions of violators of export control regulations. U.S. experience has shown that highly visible prosecutions can capture the attention of many exporters.

Recommendation: Continue to cooperate with counterpart agencies that have received computers and related equipment to ensure that automated licensing and customs tracking systems are installed and used as planned.

Recommendation: Expand bilateral cooperation among customs officials, emphasizing training and demonstration programs that can have multiplier effects in view of the vast responsibilities of the customs services.

Recommendation: Share with enforcement counterparts information on procedures used in the United States to collect evidence and prosecute parties found to be violating export control laws.

Recommendation: Encourage high-visibility prosecutions of export control violators in the four countries so that local exporters become aware of the consequences of violations of export control laws and regulations.

III. Focus on Critical Commodities, Stewardship and Compliance at the Enterprise Level, and Regional Approaches

Specific Finding: In addition to providing the basis for comprehensive approaches to export control, strategies should focus on immediate solutions to reducing the likelihood of diffusion of sensitive items. In this regard, an emphasis on layers of protection for the most sensitive items could help reduce the most serious concerns. In addition to national review procedures and checks at customs control points, control of items at the enterprises and institutes and improved capabilities for intercepting items en route to their final destinations, including during transit through neighboring countries, could both deter and complicate the efforts of parties intent on theft or diversion of controlled items.

Recommendation: Emphasize control of the most sensitive items by targeting educational and enforcement efforts on the organizations most likely to handle such items.

Recommendation: Encourage the strengthening of surveillance at the enterprise level through enhanced capabilities of on-site customs officials.

Recommendation: Expand interactions between officials of American

companies and foreign enterprises responsible for internal export compliance programs and for industry and government counterparts how the U.S. private sector participates in the development of new export control regulations.

Recommendation: Encourage local officials involved in the Customs Union in the FSU to strengthen approaches for monitoring transshipments of controlled items.

Recommendation: Participate in cooperative programs with countries of Central Asia that emphasize the importance of countering smuggling and inappropriate transshipments of sensitive items.

IV. Increase Attention to Control of Technical Data

Specific Finding: Some nations and subnational groups of proliferation concern could benefit significantly from access to technical data about the design, manufacture, and/or integration of weapons system components. Yet this threat is receiving relatively little attention in the FSU. While Russia, in particular, still protects documents classified for military reasons, there is less attention to restrictions on unclassified technical data that should be controlled pursuant to international agreements concerning exports of sensitive items. Some sensitive information is considered to be intellectual property and subject to limited distribution in the absence of patent or copyright protection, but controls on such information are uncertain at best. At the same time, data controls should not unnecessarily inhibit the exchange of information that is not explicitly subject to controls and that is central to the viability of international scientific endeavors.

Recommendation: Encourage counterparts in the four countries to strengthen national regulatory and organizational frameworks for regulating flows of technical data subject to export controls.

Recommendation: Develop and disseminate "model" technical data provisions that could be used by institutions in the FSU in contracts with domestic or foreign organizations involving controlled items.

V. Encourage Full Consideration of Proliferation Issues in Export Control Decisions

Specific Finding: While bilateral activities have concentrated on establishing the machinery for export control activities, they have devoted little effort to the policy considerations that should underpin decisions, other than consistency with the limited requirements of the international regimes. Such discussions are the

subject of separate diplomatic discussions when specific issues arise. Given economic realities, the governments of the successor states inevitably give less weight than would the United States to restricting trade with nations that pose proliferation risks. The involvement of strong nonproliferation advocates in the FSU in interagency deliberations can help ensure that appropriate attention is given to international security concerns in export control decisions.

Recommendation: Ensure that continuing consultations on the importance of export control activities in meeting nonproliferation objectives become an integral component of U.S. bilateral relations with the successor states in both the short and the long terms, as has been the case with relations between the United States and its traditional allies.

Recommendation: Promote bilateral discussions of the relationships between exports of sensitive items and proliferation concerns in many forums, at the governmental and nongovernmental levels.

Recommendation: Support the development of cadres of nonproliferation specialists in the FSU who have strong linkages with both policy officials in their countries and colleagues abroad.

The returns during 1995 and 1996 on U.S. investments in bilateral programs in MPC&A and export control were significant. U.S. agencies now have in place an extensive web of international arrangements involving very supportive foreign counterparts. The base of international experience can facilitate future program efforts that contribute directly to nonproliferation objectives.

Cutting across all program elements is the need for the United States to emphasize *cooperative* rather than *assistance* programs. This approach will help ensure that the countries will be ready to assume full responsibility for upgrading and maintaining systems that are internationally acceptable.

Despite the progress through bilateral efforts, the size of the tasks in each of the countries remains great. Reducing to an acceptable level the risk of unsanctioned transfers of weapons-related items from the FSU to states of concern or to terrorists will require many years of effort at the international, national, and facility levels by governments and specialists throughout the region. Continued participation by American specialists in the activities of these countries can accelerate the process while also providing the United States with valuable linkages to important organizations and institutions. American national security interests will be well served by a continuation of these two relatively inexpensive programs.

2

Introduction

TWO NONPROLIFERATION TOOLS: MPC&A AND EXPORT CONTROL

This study reviews the effectiveness of U.S. bilateral programs initiated in the early 1990s to support the efforts of Russia, Ukraine, Kazakstan, and Belarus in strengthening two important mechanisms for controlling the diffusion of militarily sensitive items.

The first set of bilateral programs addresses the need to upgrade the security of fissile material in the former Soviet Union (FSU) through adequate materials protection, control, and accountability (MPC&A) systems. Of special concern are the stocks of unirradiated uranium enriched to a level of 20 percent or greater (referred to herein as highly enriched uranium or HEU) and of separated plutonium of weapons grade or reactor grade (referred to herein as plutonium).[1] Such

[1] The amount of material required for a nuclear weapon depends on many factors. A primitive weapon requires considerably more than modern designs. The figures traditionally quoted for HEU assume greater than 90 percent U-235; quantities required for a weapon using lower enrichments are much larger. The isotopic mix of plutonium isotopes also has a significant effect. Impurities and diluents rapidly increase the quantities needed. For the purposes herein it is sufficient to note that the quantities required are measured in kilograms.

material is located in hundreds of buildings at widely dispersed facilities.[2] Most Efforts to help contain nuclear and other dangerous materials and technologies in the Former Soviet Union[3]

Because HEU and plutonium can be used in weapons without further enrichment or difficult chemical reprocessing, they are referred to as direct-use material. The problem of obtaining such direct-use material is a principal technical barrier preventing terrorists or countries of proliferation concern from acquiring a nuclear weapons capability. Many other commodities and technologies also are required to construct a weapon, but most of the items are probably more readily obtained than direct-use material.[4] Thus, control of direct-use material is an essential aspect of preventing nuclear proliferation.

The second set of programs is directed to the development of effective export control systems for limiting the transfer from Russia, Ukraine, Belarus, and Kazakstan of militarily sensitive commodities and technical data that have been identified by the international community as deserving concerted attention by all nations. Hundreds of enterprises and institutes developed and produced such commodities in the four successor countries, and some continue such production activities. Many facilities, as well as dozens of warehouse and trading organizations, currently have inventories of these commodities, together with technical information about their design and manufacture.[5]

The worldwide availability of much of the equipment and technical information necessary for design, construction, and delivery of weapons of mass destruction and advanced conventional weapons is increasing each year. Also, the number of scientists and engineers with training related to weapons design and development is growing in most countries of proliferation concern. However, some critical materials and components for weapons systems and a great deal of essential know-how are largely confined to a few industrialized countries. Steps to limit the international spread of selected items greatly complicate the task of nations and terrorist groups attempting to acquire such weapons.

Although MPC&A and export control programs are intended to help prevent proliferation of advanced weapons and weapons systems, the characteristics of

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[2] In this report the term "facility" is used to denote a collection of buildings and/or structures that serve a common purpose. A facility may contain more than one building; in some cases, two or more facilities may be grouped at one site, such as Tomsk-7, which has at least six facilities.

[3] Many of these sites are listed in *Nuclear Sites of Russia and the Newly Independent States of the Former Soviet Union* (Washington, D.C.: International Safeguards Division, U.S. Department of Energy, September 1995).

[4] Modern nuclear weapons require thousands of components, and even crude weapons require hundreds of components made to strict specifications. Controls on these components or the capabilities to produce them are thus also targets of efforts to prevent the proliferation of nuclear weapons.

[5] The Bureau of Export Administration of the U.S. Department of Commerce has produced directories on the defense industries of Russia, Ukraine, and Kazakstan that list hundreds of enterprises, and these directories are clearly not exhaustive.

the two programs are very different. MPC&A activities concentrate on a single

item—direct-use nuclear material. They rely heavily on systems for limiting access to storage areas and for accounting of material. These systems are designed to assist security personnel in the prevention of theft or diversion of direct-use material at the facility level and in transit between facilities and, when such prevention fails, to ensure the prompt detection of such thefts or diversions.

Export control activities, by contrast, refer to a far more diffuse effort, embracing many different types of materials, equipment, and technical data and involving many government agencies. They include establishment of a legal framework; a licensing procedure; enforcement mechanisms, including programs for finding and prosecuting violators of export control laws and regulations; and programs to inform exporters of their obligations under an export control system. Also of importance is integration of technical expertise into the export control infrastructure.

Nonetheless, there is a linkage between the two types of programs. They are mutually reinforcing in helping to achieve the goal of a less-threatening world.

FOCUS OF THE STUDY: THE U.S. RESPONSE FOR CONTAINING SENSITIVE ITEMS IN RUSSIA, UKRAINE, BELARUS, AND KAZAKSTAN

The U.S. Policy Context

For a number of years the United States has taken a variety of steps to reduce the likelihood that nuclear, chemical, or biological weapons, missile technologies, or technologically advanced armaments from any source would move freely in international commerce. Central to this effort has been strong support for the establishment and operation of international control regimes directed to international sales and other types of transfers of various categories of weapons and delivery systems. These regimes are designed to stimulate and coordinate restraint when appropriate by the member nations so as to prevent states of proliferation concern or terrorist groups from obtaining access to materials, equipment, or technical data that could enhance their capabilities to develop or use new weapons systems.

The international spread of direct-use nuclear material is addressed specifically in the Treaty on Non-Proliferation of Nuclear Weapons, commonly referred to as the nuclear Non-Proliferation Treaty (NPT), and by associated groups of supplier nations.[6] The related program of nuclear safeguards of the International Atomic Energy Agency (IAEA) and the agency's role in developing guidelines

[6] See Article 3 of the NPT. Additional information on the Nuclear Suppliers Group can be found in International Atomic Energy Agency, "Information Circular: Communication Received from Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment, and Technology," INFCIRC/254/Rev.2/Part 1, October 1995.

on the physical protection of fissile material have been important in stimulating interest in MPC&A upgrades.

As shown by Table 1.1 in the Executive Summary, the system of export control is based on a series of interlocking control regimes. However, the framework for export controls is still evolving. The former Consultative Group and Coordinating Committee for Multilateral Export Controls (COCOM), which had concentrated on limiting access of the FSU and its allies to western weapons and technologies, was dissolved in 1994. In its place the western countries established another international regime, the Wassenaar Arrangement, with an expanded membership that includes Russia, Ukraine, and several Central European countries. This regime addresses the proliferation aspects of conventional armaments and of dual-use technologies not encompassed in the other regimes.[7]

Within this framework of global regimes, the U.S. Government has gradually assumed international leadership to help prevent the diffusion of sensitive material and equipment, particularly direct-use nuclear material, from the successor states of the FSU. The U.S. Government has actively encouraged the key industrial countries of the region to conform their export control policies to the requirements of the international regimes. Also, the United States has mounted diplomatic efforts in the region to discourage proposed sales of certain sensitive items, even though such sales are not prohibited by the regimes (e.g., the Russian sale of nuclear reactors to Iran).

Of great importance, the United States has initiated bilateral consultations and programs to upgrade MPC&A and export control systems in the FSU, as discussed below. Related efforts have included reductions of direct-use material stockpiles through American purchases of substantial quantities of HEU from Russia and Kazakstan, investigations of alternative sources of energy to the Russian plutonium production reactors in Tomsk and Krasnoyarsk, support for cooperative projects that diversify production activities at weapons-oriented enterprises into the civilian sector, and development of economic incentives for FSU weapons scientists and engineers to redirect their efforts to peaceful pursuits rather than be tempted to look abroad for customers for their weapons know-how. The range of programs reflects the significance of the underlying nonproliferation objectives.

Bilateral Cooperation in Containment of Direct-Use Material and Export Control

As a number of the foregoing efforts progressed on a cooperative basis from 1992 to 1994, the U.S. Government encountered many difficulties in developing

[7] Under Secretary of State for Arms Control and International Security Affairs Lynn E. Davis discussed this in detail in her speech at the Carnegie Endowment for International Peace, Washington, D.C., January 23, 1996.

significant bilateral efforts in MPC&A and export control, despite the availability of funding from the U.S. Congress. Nevertheless, during this period interested American experts from both the public and the private sectors took advantage of limited opportunities to acquaint officials of the region with western approaches in both fields. In time, administrative and political problems in Washington and the region diminished. Since the beginning of 1995, a number of U.S. government agencies and laboratories have been quite successful in participating in bilateral programs directed at these two core national security concerns.

In these programs the U.S. agencies measure progress toward the goal of nonproliferation by (a) the amounts of direct-use material contained in secure MPC&A systems, and (b) the extent to which functioning export control regulatory systems, including enforcement mechanisms, have been established. The agencies realize that such measures do not adequately portray success since they do not indicate the seriousness of the remaining vulnerabilities in the systems. In addition, it is difficult to measure the precise impact of U.S. programs because of growing commitments by the countries themselves to nonproliferation goals. Still, the agencies consider the two measures useful indicators of program accomplishments.

Multiple Motivations for Collaboration

While the governments of Russia, Ukraine, Belarus, and Kazakstan have become increasingly sensitive to the potential for proliferation of weapons of mass destruction, other considerations also underlie their interests in bilateral cooperation in MPC&A and export control. For example, recognition as a responsible member of the IAEA is very important politically to each of the four governments because they rely on international support for a variety of activities in the nuclear field. These governments understand that reliable export control systems can help them gain reputations as acceptable trading partners, thereby enhancing access to western markets and technologies.

In addition, Russia wants to be widely perceived as a world leader in the development and deployment of nuclear and aerospace technologies for peaceful purposes, and Ukraine seeks broad recognition for its achievements in developing technologies for applications in space programs. Conformance with international norms in relevant areas is important in gaining acceptance in international political arenas.

The objectives of the four governments in bilateral cooperative programs extend beyond political benefits and technical improvements. In particular, they welcome opportunities for international travel and for obtaining additional financial resources for staff salaries and equipment purchases. They also seek improved physical protection systems in order to counter sabotage, espionage, and thefts of all types of valuable items at nuclear installations and other facilities of concern.

These multiple objectives of the participants in joint efforts increase the need

SCOPE OF THE STUDY

Materials and Equipment Emphasized in This Study

MPC&A Activities

Both the security of nuclear weapons in Russia and the containment of direct-use nuclear material there and in several other successor states are major concerns of the United States and other western governments. Significant U.S. programs are directed to strengthening Russia's control over nuclear weapons that are under the custody of the Russian Ministry of Defense. Control of these weapons has been addressed by others and is outside the scope of this study.

In evaluating controls on direct-use material, the committee focused on the major U.S. bilateral programs, particularly those managed on the U.S. side by the Department of Energy (DOE). Because DOE had not yet begun work at the weapons assembly and dismantlement facilities at the time of the committee's visit to Russia, the committee did not consider the security of weapons components at these facilities or in transit to and from the facilities. The committee also did not address programs of the U.S. Department of Defense concerning direct-use material that is under the control of the Russian Ministry of Defense, material primarily in weapons, although the study did examine DOE activities directed to security of material used by the Russian navy and the icebreaker fleet.

Direct-use material can exist in many forms; it may be a pure metal, a compound, or an alloy. It may also be in components that are to be incorporated into weapons, in fresh nuclear fuel rods, or in the form of powder in storage containers. It may be in scrap or off-specification material that has been set aside as waste. It may exist in various states in chemical processing facilities. All such forms were considered, but the committee did not consider safeguards of spent reactor fuel elements or other irradiated material because DOE gives them lower priority relative to the abundant, more readily accessible stocks of direct-use material.

Export Control

Export controls are aimed at controlling international commerce in a wide range of materials, equipment, and technical information with military applications to end users and countries of concern. Good starting points for identifying such items are the lists of controlled commodities associated with the international control regimes. Some regimes distinguish between items considered critical or sensitive and items of less concern. Table 2.1 sets forth examples of

TABLE 2.1 Examples of Controlled Items[a]

	Sensitive Export and Dual-Use Items Lists
Nuclear Materials	The Nuclear Suppliers' Group (NSG) and Zangger trigger lists include source material and special fissionable material such as HEU, plutonium, and thorium. The NSG dual-use list includes boron, beryllium, bismuth, zirconium, and magnesium.
Nuclear Equipment and Facilities	The NSG and Zangger trigger lists include reactors, reprocessing and fuel fabrication plants, and related equipment specially designed or prepared for such facilities. The NSG dual-use list includes items not especially designed or prepared for the above facilities but that can be used in them and also includes industrial items useful for the manufacture of nuclear weapons, such as implosion systems development equipment, explosives and related equipment, and nuclear testing equipment and components.
Chemical Materials	The Australia Group list currently contains 54 controlled chemicals (all precursors). The core list chemicals include thiodiglycol, phosphoryl chloride, dimethyl methylphosphonate, methylphosphonyl difluoride, and methylphosphonyl dichloride. The related chemical weapons agents are sulfur mustard, sesqui mustard, tabun, sarin, somon, and GF.
Chemical Equipment	The Australia Group dual-use chemical equipment list includes reaction vessels, reactors, agitators, storage tanks, containers, receivers, heat exchangers, condensers, distillation and absorption columns, filling equipment, valves, multi-walled piping, pumps, and incinerators.
Biological Materials	The Australia Group core and warning lists include bacteria, rickettsiae, viruses, toxins, and genetically modified microorganisms. The disease agents of concern include anthrax, plague, tularemia, cholera, Venezuelan equine encephalitis, Q fever, botulism, and staphylococcal enterotoxemia (food poisoning).
Biological Equipment	The Australia Group dual-use biological equipment includes complete containment facilities at P3 and P4 containment levels, fermenters, centrifugal separators, cross-flow filtration equipment, freeze-drying equipment, and aerosol inhalation chambers.
Missile-related Items	The Missile Technology Control Regime Category I encompasses complete rocket systems (including ballistic missile systems, space-launch vehicles intended to carry weapons of mass destruction, and sounding rockets) and unmanned air vehicle systems (including cruise missiles, target drones, and reconnaissance drones); individual rocket stages; reentry vehicles and equipment; solid- or liquid-propellant rocket engines; guidance sets; thrust vector control subsystems; and weapons and warhead safing, arming, fuzing, and firing mechanisms. Category II includes a wide range of missile components and subsystems.
Conventional Arms and Dual-Use Technologies	The Wassenaar Arrangement munitions list includes 22 categories of conventional armaments, ammunition, and related items. The Wassenaar Arrangement list of dual-use goods and technologies includes advanced materials and materials processing equipment; electronics; computers; telecommunications; information security systems; and sensors and lasers for navigation, marine, and propulsion applications.

[a] See Appendix A for a discussion of the international control regimes.

Source: U.S. Department of State.

controlled items, particularly critical items that are to receive priority consideration. Effective export control requirements encompass a much broader range of nuclear-related materials than only direct-use material. Also, many types of nuclear equipment are included on international control lists.

Export control activities are frequently divided into the control of weapons (or "munitions") and the control of dual-use items. In Russia, two different review procedures are followed for the two types of items. In the other countries of interest, both categories of items are subjected to a single review procedure. Various different participants in the process adjust their roles depending on the type of item under consideration. As required by the terms of reference for this study, the committee gave special attention to controls on dual-use technologies. At the same time, it recognized that state-sanctioned sales of munitions or illicit trade in munitions can often present much greater threats to international security than international transfers of controlled dual-use items.

Of special note, Russia inherited a large storehouse of facilities, equipment, and technology related to biological and chemical warfare that should be carefully controlled until they are destroyed or dismantled in accordance with international commitments. While the U.S. Government has undertaken limited efforts to help secure and eliminate such items, a detailed review of these activities was beyond the scope of this study.

Countries of Interest

The vast majority of the U.S. effort to help contain direct-use material in the FSU has concentrated on Russia, where most of the material is located. Important, but modest, activities have been under way in Ukraine, Kazakstan, and Belarus, where direct-use material remains at a few research centers and one breeder reactor in Kazakstan. Also, in Russia and Ukraine, upgrading the security of nuclear power stations is of high priority to the governments, which are concerned with sabotage; this interest intersects with their efforts in physical security enhancements for MPC&A purposes.

The U.S. cooperative program with Russia in export control has emphasized exchange visits involving very important Russian specialists from government and industry. The U.S. program has also included limited technical cooperative programs at the laboratory-to-laboratory level. A more ambitious program would probably require a formal bilateral agreement between the U.S. Government and the Russian Government—a step that was not possible several years ago because of Russian concerns over U.S. auditing procedures.[8] Cooperative programs in-

[8] A Memorandum of Intent between the United States and Russia was signed in January 1994 that provides for export control exchanges and seminars.

volving Ukraine, Kazakstan, and Belarus are based on formal agreements and In the other successor states, the U.S. Government has begun to involve key officials in regional seminars and group visits to the United States.

Overall, this study emphasized activities in Russia, where the greatest threats to nonproliferation exist, and to a lesser extent Ukraine, Belarus, and Kazakstan. The presence of small amounts of direct-use material at research sites in Latvia, Uzbekistan, and Georgia, which is subject to IAEA safeguards, has been recognized. Some eventually may be returned to Russia; but, in any event, its presence opens still other opportunities for smuggling. These and neighboring countries of the region are potential routes for smuggling other sensitive items as well and for transshipments of controlled items. Thus, the weaknesses in their efforts to counter proliferation cannot be ignored.

Countries in Central Europe also are of concern because of both smuggling and transshipments of controlled items. In a few cases they produce controlled commodities. However, recent efforts by the U.S. Government to cooperate with Central European countries in MPC&A and export control were beyond the scope of this study. Also, there have been a number of reports of smuggling of nuclear items in Germany that were believed to have originated in the FSU; but the security environments in the western countries of Europe are quite different from the situation in the former Soviet Union, and interdiction procedures in Western Europe were also beyond the scope of this study.

COMMITTEE'S APPROACH TO REVIEWING PROGRAM EFFECTIVENESS

The committee recognized from the outset that there were no good quantitative measures of the effectiveness of U.S. programs in supporting efforts in the four successor countries to upgrade their controls on sensitive items. First, there was great uncertainty as to the effectiveness of existing controls, the security conditions at production and research facilities, and the capabilities of personnel at both the national and the facility levels in the four countries at the time the U.S. programs were initiated. Hence, there was not a good baseline against which to measure progress. Second, it was not possible to separate the contributions of American participation from the progress that would have been made without U.S. involvement. Finally, there are no reliable data concerning legal transfers of sensitive items out of the region, let alone contraband goods which may not even be known to national authorities, complicating assessments of the impact of upgrades on proliferation.

The committee thus relied on qualitative assessments of whether U.S. agencies were effectively using opportunities to stimulate action by counterparts to upgrade their regulatory and security systems. In assessing reductions in the likelihood that sensitive items would reach countries or subnational groups of

concern, the committee relied on the same surrogate indicators of progress cited by the U.S. Government and described above for functioning components of MPC&A and export control systems.

Of course, the well-developed approaches in MPC&A and export control that are practiced in the United States and many other western countries provided starting points for reviewing the efforts of the four successor countries in these fields and of the programs of the U.S. agencies. However, the physical infrastructure, financial conditions, local security and law enforcement capabilities, and many other social and economic factors in the region differ significantly from conditions in the United States and even vary considerably among the four countries. Thus, the committee gave considerable attention to opportunities for adapting American experience in different environments. Also, a number of years are needed for the countries to have fully developed systems for containing sensitive material, equipment, and information. The committee therefore considered interim approaches that could help contain leakages in the immediate future.

Throughout this report, footnotes provide the reader with background and source information. Where absent, the statements are based on committee site visits and discussions with FSU officials.

ORGANIZATION OF THE REPORT

The present report is divided into five chapters, including the Executive Summary and this Introduction. Supporting documentation is included in the appendices and identified in the footnotes. Chapter 3 describes the environment in the FSU, particularly in Russia, Ukraine, Belarus, and Kazakstan. In setting the stage for the remainder of the report, the chapter reviews recent developments in the successor states that have a bearing on the need for and character of MPC&A and export control systems. The changing political scene, the economic problems, the growth of crime, the commodities and technologies of concern in the successor states, and the interests of countries of proliferation concern are considered.

Chapter 4 addresses MPC&A. The vast size and security conditions of the Soviet nuclear complex are described, and the types of potential threats to nuclear facilities are discussed. Steps being taken by the governments of the region to upgrade MPC&A systems, as well as the organizational and budgetary issues faced by both the Russian and the U.S. Governments, are described. Comments are offered on the adequacy of the programs in addressing threats and the appropriateness of the focus and priorities of the programs. Specific findings as to the effectiveness of U.S. programs and recommendations on how the programs can be made still more important are presented.

Chapter 5 addresses export control. The types of products and facilities of the former Soviet military-industrial complex are discussed. The various elements of western-style export control systems are presented, along with a discus-

sion of the state of development of such systems in the region. Enforcement efforts to help contain the possibility of proliferation of nuclear and other dangerous materials and technologies in the former Soviet source are underscored. A review of U.S. efforts and recommendations for refining the U.S. approach are presented.

In summary, the report concentrates on its two principal tasks: (a) to assess the effectiveness of current U.S. efforts to cooperate with Russia, Ukraine, Belarus, and Kazakstan as they seek higher standards of security for direct-use nuclear material and to recommend possible new directions, and (b) to assess U.S. cooperative activities that address potential transfers from the four successor states of a wide range of other sensitive materials and technologies and to recommend additional steps to address this proliferation problem.

3

The Environment for Containment of Advanced Weapons Technologies in the Former Soviet Union

SOCIETIES IN TRANSITION

Uncertain Political Stability in the Successor States

Despite all of its undesirable features, the Soviet Union was the world's second-leading industrial country and offered a high degree of political predictability. Now, new independent states have replaced it, and all of them are witnessing the impacts of a realignment of sovereignty and the transition to new political, social, and economic forms. While long-term stability is the goal of each of the successor countries, such difficulties as economic decline, loss of social safety nets, growth of organized crime, increased ethnic conflicts, and widespread social anxieties currently characterize many of the fragmented parts of the former Soviet Union (FSU).

Since independence, political leaders in many successor states have attempted to establish radically new political and economic institutions. Western governments have applauded the long-term goals, especially the claims of many leaders that these efforts will enable the populations to have more direct voices in the evolution of their own societies. However, the current dislocations of millions of highly trained specialists and other workers have brutally shaken the social fabrics of the countries of the region. Also, the disruptions of governmental regulatory mechanisms and of economic and social support systems have resulted in both a sense of freedom of action and a feeling of financial abandonment at the enterprise and individual levels. There appears to be a widespread presumption

that, at least for the immediate future, few political constraints will be placed on *Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union*

While in recent years countries throughout the world have undergone transitions to new forms of governance and to market economies, the national security dimension of the transitions in several countries of the FSU is unique. Russia possesses not only a ready inventory of nuclear weapons, but also the capability to develop, manufacture, and use other types of advanced weapons with sophisticated delivery systems. In addition, several other countries in the region have the capabilities to produce components that are core elements of such weapons and delivery systems. Also of great importance are the substantial quantities of direct-use nuclear material located at many sites in Russia and, to a lesser extent, in several other successor states.

The combination of political uncertainty, economic deprivation, and availability of advanced weapons technologies has raised genuine concerns in many western countries over the determination and capability of a number of the successor states to maintain control over sensitive material, equipment, and technical information.[1] Anxieties initially centered on nuclear-related items but now include biological and chemical weapons technologies and components for missile delivery systems. These concerns have become particularly acute in light of the many reports of attempted theft by criminal elements of items that might be of interest to other states and to terrorist groups. While most reported thefts have never been substantiated and the several confirmed reports of greatest concern involve only small quantities of direct-use material, the large number of reports—together with observations by western visitors of inadequate security measures attendant to sensitive commodities—has raised the immediacy of the issue among western governments.

At the same time, the future political course in many of the successor states is far from clear. This is particularly troubling in Russia, where latent forces of nationalism and communism continue to raise the possibility of a return to the past. According to some political scenarios, Russia not only must mobilize existing forces but also might revive its dormant military production facilities, either for reasons of national security or national pride. Such action would undoubtedly be viewed as a hostile act by both near neighbors and distant foes of the past.[2]

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[1] Sen. Richard Lugar (R-Ind.) has called proliferation "the greatest threat to the national security of the United States" (Opening Statement of U.S. Senator Richard Lugar, Subcommittee on European Affairs, Senate Foreign Relations Committee, August 23, 1995).

[2] The "cold warrior" speech by Russian Foreign Minister Andrei Kozyrev on December 14, 1992, outlined the possible foreign policy positions of a communist government. If his intent, as he later claimed, was to remind the West of the dangers, he succeeded. See New York Times, December 15, 1992, p. A 16:12. For other possible scenarios, see Daniel Yergin and Thane Gustafson, *Russia 2010—And What It Means for the World* (New York: Random House, 1993).

Economic Dislocations and the Internal Security Environment

Economic problems are pervasive throughout the region. While a small portion of the population in each country has prospered during the past several years, most have not fared well. Workers in the former Soviet weapons complex who previously enjoyed generous economic benefits and other privileges not generally available to the rest of the population are for the first time faced with low and uncertain paychecks and even with the loss of their jobs.[3] Also, ministerial personnel with oversight responsibilities for sensitive activities have suffered serious reductions in real wages, together with declining professional standing in the eyes of the population.

Restructuring the defense-related sectors, including defense conversion, is necessary in the FSU. However, it is a slow and occasionally chaotic process; and during these uncertain times, many managers, workers, and bureaucrats in the defense-related sectors are seeking new sources of incomes. Although some have been able to establish lucrative careers in the private sector, others pursue dual careers, both within and outside their home institutions, or search for new approaches to capitalize on previous large state investments in defense technologies.

Against this background, the governments of Russia, Ukraine, Belarus, and Kazakstan are attempting to put into place new types of regulatory and security constraints for controlling militarily sensitive material and equipment. The systems and personnel they inherited from Soviet times provide the point of departure for introducing new approaches—often patterned after western experience—that are more appropriate for emerging market economies and that are capable of coping with the problems accompanying economic decline.

The Lingering Soviet Security Legacy

Security measures for sensitive material, equipment, and technical information were extraordinarily tight in the Soviet Union. Indeed, extreme measures were often applied to protecting items that in the West would not be considered highly sensitive, such as civilian transportation and communications equipment.

Physical security at the institute and enterprise levels was rigorous. Closed laboratories existed in closed enterprises in closed areas in closed cities in closed regions. In Moscow and other open cities a number of educational and basic research facilities, as well as institutions more directly related to military activities, were cordoned off for decades from the general populace for national secu-

[3] In 1992, defense orders in Russia were 68 percent lower than in 1991 (Gennadi Petrovich Voronin, "How Russia's Defense Industry Responds to Military-Technical Policy," *Comparative Strategy*, vol. 13, no. 2, April 1994, p. 81). In the same period, military orders in Kazakstan dropped 82 percent. (Andrei Kortunov, Yuri Kulchik, and Andrei Shoumikhin, "Military Structures in Kazahkstan," *Comparative Strategy*, vol. 14, no. 3, July 1995, p. 302).

rity reasons. At leading technical universities, for example, nuclear research reactors, acoustic laboratories, and other facilities were usually considered to be militarily sensitive facilities.

The isolation of military-related research and production activities, both from each other and from civilian capabilities, was a common practice. There was minimal attention to opportunities for dual-use applications of skills, equipment, or production activities.[4] Even in small closed cities, residents often were unaware of the professional activities of neighbors; and in laboratory buildings, specialists frequently had little idea of the purposes of activities in rooms adjacent to their own workstations. Checkpoints and search procedures were well established, and armed guards were omnipresent.

A plethora of organizations were involved in developing and enforcing local security procedures, with the Ministry of Internal Affairs, the State Security Committee, and the Ministry of Defense providing most of the well-paid manpower. Each ministry and organization responsible for production, services, or research activities (e.g., Ministry of Atomic Energy, Ministry of Health, Ministry of the Chemical Industry, Academy of Sciences) also had its own security personnel; and regional and local authorities were participants in a system that emphasized layers of both physical and organizational security procedures.

The core of the security philosophy was continuous monitoring of the activities of *people*, since only people could divert or steal items. This meant that it was necessary to keep unauthorized people out of certain facilities and to ensure that the workers at the facilities did not violate procedures. The approach of maintaining constant scrutiny over sensitive segments of the labor force worked well in a political system where personnel surveillance was widespread.

Meanwhile, at the national level, decisions concerning trade and other international technology transfer arrangements were highly centralized. The likelihood was small that individual officials or even ministers might make arrangements for shipping material or equipment abroad. Of course, once a decision was made for the international sale of a selected item or for cooperation with an institution in another country in a specific technical area, the ministry that carried out the decision sometimes could interpret its instructions in ways that resulted in different types of transfers of technology than might have originally been portrayed. Still, renegade ministers—acting alone and in isolation from the security forces—were few in number. Even the minister who arranged the export of caviar packed in sardine cans in the 1980s was quickly discovered and imprisoned.[5]

Finally, the possibilities for theft or diversion of sensitive material or technologies from within the Soviet Union by foreign agents, acting alone or in

[4] Tarja Cronberg, "Civil Reconstruction of Military Technology: The U.S. and Russia," *Journal of Peace Research*, vol. 31, no. 2, May 1994, pp. 213-217.

[5] This situation was discussed with American specialists involved in bilateral cooperation in fisheries research during the late 1980s.

concert with disloyal Soviet insiders, were not very great. While Soviet exports to countries of proliferation concern and other dangerous exports were commonplace, the exports of these items were, by and large, carefully considered actions approved at high levels in the government.

Changes in the Security Environment

The security environment in the FSU is quite different today than in former times. Of course, security systems are still in place, and penalties for security violations are severe. Also, export regulations, although still early in development, exist in the largest successor states; and these regulations, at least on paper, require that international sales and other transfers of material and technologies be approved by appropriate government agencies.

Nevertheless, the erosion of security systems is evident, even in facilities where direct-use material is present. Also, particularly in Russia, the central government no longer has the pervasive direct control over all significant activities at the enterprise and institute levels that it once exerted, even though most key institutions remain either state owned or state controlled. Thus, managers at the local level believe they have a newly acquired prerogative to control the assets of their organizations in a manner that will be of most benefit to their institutions. These managers also have new responsibilities for financing their own facilities, including their security systems; with financial shortfalls, the security systems are not immune from budget cuts.

Technical information related to advanced technologies has become a new type of commodity in the evolving market economies. It is increasingly used by enterprise and institute leaders to attract customers from abroad, and it seems unlikely that their decisions to release information take into account export control considerations, even though the information may be subject to the requirements of international control regimes.

In short, control over industrial activities in Russia and the other successor states is being decentralized in very uncertain ways. The managers at various levels who have been involved in industrial activities may not be eager to clarify the currently blurred responsibilities for control of defense assets and related authorities for fear they might lose some of their newly-won autonomy. The situation as to security requirements and responsibilities may become still cloudier in some countries as privatization begins to encompass defense-related firms.

Idle Scientists and Idle Equipment

In Russia and several other countries of the FSU, the sharp reduction in military orders has left many scientists and engineers unemployed, with empty

pockets and time on their hands.[6] Sophisticated machinery sits idle, excess components and raw materials and waste products clutter many establishments. Administrative personnel responsible for financial accounting, inventory control, and facility maintenance also have been reduced. Questions linger as to whether buildings may have been abandoned without a careful inventory, sorting, and, as appropriate, safeguarding of their contents. Thus, concerns abound in the West as to whether sensitive items remain in responsible hands.

Search for Industrial Conversion Opportunities

At the same time, directors of enterprises and institutes engaged in activities involving sensitive material, equipment, and technical data search for new sources of financial support. They do not seem inhibited by export laws and regulations in their entrepreneurial efforts.[7]

While undermanned security staffs would like to minimize access to sensitive facilities, most enterprises and institutes that were part of the Soviet military-industrial complex have opened their doors to outsiders interested in applying Soviet military know-how to civilian activities.[8] Relatively few paying customers from within the FSU or from abroad have been attracted to the products of industrial conversion efforts, but the new industrial entrepreneurs nevertheless continue their efforts to find previously untapped sources of income. There is no other alternative if they are to meet their payrolls.

Many enterprises and institutes have unveiled previously concealed military technologies that have possible commercial applications, hoping that their products will find markets. Increasing numbers of foreigners are being invited into facilities they had once known only as dark anonymous recesses in the industrial landscape. While it presumably is clear that material or equipment is not to be removed from these premises without evidence of completion of formal procedures, there often seems to be confusion as to whether documents and other types of information that reveal the essence of the technological achievements can be sold or given as an enticement to visitors.

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[6] For example, see Alexander Gordeyev, "Out of Work, Can Build Chemical Weapons," *Moscow Times*, June 3, 1994, p. 5, which describes the conditions at the Shikhanyi Branch of the State Research Institute of Organic Chemistry and Chemical Technologies, and Bill O'Neill, "What Can You Do with a Missile Designer?," *New Scientist*, vol. 138, no. 1871, May 1, 1993.

[7] This general impression was reinforced by discussions at specific facilities during the committee visit to Russia in May 1996.

[8] Some, but not all, of the most sensitive nuclear, chemical, and biological research and production institutions remain tightly sealed from outsiders.

As to commercial uses of controlled material (e.g., isotopes, titanium alloys, electronic components, advanced composite materials, optical sensors), many local advocates of conversion have actively promoted the sale of such items for quick financial returns. Ministry officials, even though they may be concerned about the need to protect the industrial know-how of a country, may have considerable difficulty resisting the lure of foreign payments at a time when cash is in short supply.

At the same time, recognizing that electronic communication and data links will further erode attempts to contain information considered to be of a proprietary nature, some enterprise directors restrict access to the Internet at their firms to centrally controlled modems.

Response of Organized Crime to Economic Opportunities

"Criminal" involvement in the sale or diversion of technological assets of the military-industrial complex of the FSU also is of concern.

As has been widely reported in the press and other publications, government officials who would be considered corrupt by western standards are frequently involved in efforts to divert the economic assets of their country to private hands, including assets of the former Soviet military-industrial complex. Indeed, the susceptibility of government officials to schemes for diverting government assets is considered to be so pervasive, particularly in Russia, that interests in personal gain influence even the most sensitive decisions.[9]

One obvious route for criminal groups to obtain access to sensitive and valuable commodities is for them to gain financial and management control of firms that possess the commodities and to sell the products abroad for quick financial returns. In Russia about 500 of the key military-industrial enterprises, including many in the nuclear and aerospace fields, will not be privatized in the near term; thus, it should be difficult for criminal elements to control these firms directly. However, the 1,500 other firms in Russia that contributed to the military effort and perhaps several hundred in the other successor states are in the process of privatization, and some might be attractive targets for penetration by organized crime.[10]

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[9] For a broad perspective of corruption in Russia, see Vladimir Shlapentokh, "Russia: Privatization and Illegalization of Social and Political Life," *Washington Quarterly*, vol. 19, no. 1, Winter 1996, pp. 65-85; Stephen Handelman, *Comrade Criminal: Russia's New Mafia* (New Haven: Yale University Press, 1995); and *Crime and Corruption in Russia*, Briefing of the Commission on Security and Cooperation in Europe, Washington, D.C., June 1994. For examples related to the military-industrial complex, see Graham Turbiville, "Organized Crime and the Russian Armed Forces," *Transnational Organized Crime*, vol. 1, no. 4, Winter 1995, esp. pp. 73-77, and Graham Turbiville, "Weapons Proliferation and Organized Crime: The Russian Military and Security Force Dimension, *USAF Institute for National Security Studies, Proliferation Series*, Occasional Paper 10, June 1996.

[10] Turbiville, op. cit., pp. 57-64.

Criminal groups are reported to be systematically penetrating the banking and other financial institutions of the region. They are then in position to exert indirect control over the activities of enterprises, including state enterprises, that depend on financing through the banking system.[11]

In addition, organized crime has targeted the security services of the region, according to local officials.[12] Employees of the security forces, which guard nuclear and other sensitive facilities, and of the customs services, which provide surveillance for illegal imports and exports at international control points and along the borders, would seem particularly vulnerable. They have suffered losses in their professional prestige and receive greatly reduced paychecks. Organizational changes, procedural changes, and hiring of inexperienced personnel have further eroded the morale of professionally competent employees who had become accustomed to exercising unchallenged authority in the past. Not surprisingly, many seek ways to supplement their meager salaries. Some are particularly well positioned to engage in illegal activities should they be so inclined.[13]

A past history of bribes offered by criminal elements at border crossing points is a major concern of the customs services of the four successor countries. Customs officials providing documentation for shipments at internal control points also have been implicated in improprieties. Again, the poor pay of customs authorities seems to be the root of the problem. Compounding this problem of bribery are the extensive external boundaries that did not previously exist and the need to establish customs services in all of the countries except Russia from scratch. Thus, it is not surprising that the extent to which sensitive items have leaked through the porous borders unbeknownst to officials in the capital cities is not known, but officials have recognized that it probably has happened.[14]

While there is no publicly available evidence that the governments of countries of proliferation concern or terrorists have allied themselves with criminal elements in Russia or other successor countries in an effort to obtain sensitive material, equipment, or technical data, such linkages in the future cannot be ruled out.

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[11] See, for example, Aleksandr Zhilin, "Financial Dealings Dramatically Increased in Russia," reprinted in *Transition*, vol. 6, no. 11-12, November-December 1995, pp. 9-10. This issue was also a major theme at a panel sponsored by the International Research and Exchange Board entitled "Organized Crime in Russia: Economic and Political Aspects" that was held at the University Club in Washington, D.C. on May 16, 1996.

[12] Committee's visit to the region in April and May, 1996. See also Turbiville, op. cit., pp. 85-89.

[13] This general impression was reinforced by many discussions during committee visits to the four countries.

[14] This issue arose, for example, in discussions during the committee visit to Kazakstan in April 1996.

Terrorist Groups in the Background?

Organized crime is rapidly spreading its reach throughout the successor states and onward across the oceans, always turning its attention to those types of activities that offer opportunities for quick financial returns. These groups are undoubtedly aware of the potential value to international terrorist organizations of military-related items left over from Soviet times or produced in Russia and other successor states.

The *Aum Shinrikyo* (Aum Supreme Truth) group used chemical warfare agents to terrorize subway passengers in Tokyo in March 1995, thereby underscoring the reality of the interests of such terrorist organizations in some of the most deadly weapons. This cult claimed more than 30,000 members in Russia. The terrorists acquired a helicopter and other equipment from Russia that presumably were to be used in chemical dispersion systems. The Russian Government apparently has cracked down on further activities of the cult.[15] However, reliance on Russian technology, albeit in this case relatively simple and uncontrolled technology, indicates the resourcefulness of such groups in developing foreign connections. The FSU will continue to be an attractive source for many types of controlled and uncontrolled items with dangerous applications.[16]

Economically and politically inspired terrorism, including state-terrorism, is on the rise throughout the world. Terrorist activity in Russia has taken many forms, including the planting of a radiation source in a Moscow park and explosive devices in the Moscow subway and in buses. Possible linkages of terrorists with criminal elements in the FSU, coupled with the availability of potent military hardware and technology, are of great concern.[17]

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[15] For information on *Aum Shinrikyo*, including the group's activities in Russia, see Murray Sayle, "Nerve Gas and the Four Noble Truths," *The New Yorker*, April 1, 1996, pp. 56-61, and "Russia: *Aum Shinrikyo* Exploits a Spiritual Void," *Asiaweek*, vol. 21, no. 18, May 5, 1996, p. 34.

[16] For additional information see testimony of the Hearing on Nuclear Smuggling and the Fissile Material Problem in Russia and the NIS by the U.S. Senate Subcommittee on Europe of the Committee on Foreign Affairs, August 22-23, 1995.

[17] Concerns about increased terrorist activity arose during committee visits to Russia in May 1996. For information on the incident in Izmailovo Park, see articles in *The New York Times* on November 24, 1995, p. A1, and November 25, 1995, p. A5. The most prominent subway bombing took place shortly before the 1996 presidential election. See details in *The New York Times*, June 12, 1996, p. A14.

WEAPONS TECHNOLOGIES OF ALL TYPES IN THE FORMER SOVIET UNION

The Expansion of Weapons Activities in the USSR

Following World War II, the United States, Soviet Union, and, to a lesser degree, certain other industrialized countries rapidly expanded their efforts to develop advanced technologies that could provide the basis for new military capabilities with greatly enhanced destructive power. The United States relied heavily on these advanced technologies to offset Soviet superiority in conventional armaments and troops.

Within a few years the technology competition between the superpowers became as important as the quantitative arms race, particularly in the nuclear and missile arenas. The two countries sought to upgrade a broad range of technological capabilities, recognizing the critical role of advanced military hardware and supporting systems in regional and local conflicts as well as in global strategic confrontations.

Much of the military technology efforts in the United States and Soviet Union during the 1950s centered on development and production of strategic bombers and intercontinental ballistic missiles. Also, intensified efforts expanded the stockpiles of highly enriched uranium (HEU) and plutonium that could be used in bombs and then in missile warheads and even artillery shells. Soon more destructive weapons using nuclear fusion as well as fission principles were a reality. Meanwhile, chemical explosives continued to be a standby of all armies; and the variety of biological and chemical warfare agents available for use increased.

In the 1960s intercontinental ballistic missiles based on land and in submarines quickly supplemented the large inventories of long-range bombers in both the United States and the USSR. In the 1970s cruise missiles and smart weapons appeared in military inventories. And in the 1980s the possibility of mounting nuclear weapons or destructive lasers on satellites gave another dimension to the design of weapons systems. Conventional battlefield technology also continued to advance, with the development of highly sophisticated tanks and short-range rockets. All the while, advances in electronics, optics, high-strength materials, and many other newly emerging technologies provided the basis for improved military systems.

The quest for more powerful, more accurate, and more effective offensive weapons systems and for defensive systems to counter the new offensive technologies soon involved a very large number of government enterprises, private-sector firms, and research and development institutions throughout the industrial complexes of many countries. Military requirements were reflected in laboratory design and testing activities, in the production of machine tools and other indus-

trial equipment, and in the manufacturing of weapons components themselves, as

Layers of Technologies Supporting Production of Military Systems

Many thousands of components are essential for a functioning weapons systems. For example, a nuclear warhead may have 4,000 or more components, in addition to the "physics package" containing the nuclear material. These include electrical arming and triggering devices, compact power sources, and containers for holding and directing the material.[18] The warhead, in turn, is but one of the many components placed into a missile or aircraft delivery system. Design and production of each of the components in the warhead, as well as the thousands of components in the delivery system, obviously have become critical focal points of efforts to use the latest technologies in all aspects of weapons development programs.

Special-purpose machinery, high-hazard facilities, and raw materials that are in limited supply are often essential in the manufacturing cycle of nuclear or other weapons material. Similarly, production of other components for the warhead or the delivery system may require unique equipment and facilities and most certainly requires specialized designs.

Stepping back one step further in the manufacturing process, new technologies may be needed to build the special-purpose machinery, to construct and equip the high-hazard facilities, and to extract and process the needed raw materials. In some cases each of these technologies may be supported by still more layers of technology.

Thus, the development and building of modern weapons involve a large variety of institutions and skills. Not only are the technologies that are incorporated into individual components critical to the effective functioning of a weapon, but the integration of these technologies into an overall system represents a highly significant technological achievement in and of itself.

Throughout this chain of interrelated production modules, skilled people are essential. Thus, efforts to prevent the spread of weapons technology must be broadly based—from containing destructive material, to controlling equipment that directly and indirectly produces the material, to safeguarding documentation that charts the course of weapons development, to discouraging a brain drain of knowledgeable personnel who could quickly reproduce well-honed approaches in countries seeking new weapons capabilities. A "defense-in-depth" strategy to inhibit the free circulation of each of the critical elements greatly complicates the efforts of any state or terrorist group intent on developing a functioning weapons system.

An important factor in efforts to prevent the diffusion of sensitive items has been and will continue to be the dual-use character of many of the technologies

[18] Briefing of committee members at Sandia National Laboratories, February 1996.

involved, including the dual applications of the destructive material itself (e.g., HEU can be blended with uranium to produce low-enriched uranium fuel, which can be used in fuel rods for civilian reactors, certain agents that are effective as biological weapons can be used in vaccines, and some chemical precursors incorporated into pesticides have the potential for use in weapons). Soviet designers seldom used civilian products as the point of departure for their weapons systems. However, Soviet leaders and now the Russian Government have been very interested in adapting military technologies for use in civilian markets. Of course, they must pay attention to the cost constraints imposed by the marketplace that were not considered in producing military hardware, particularly in the USSR, where cost control did not receive high priority.

Nuclear Weapons Capability

All nuclear weapons of the Soviet military forces have been returned to the confines of Russia. They number in the tens of thousands. Operational warheads are within the custody of the Russian Ministry of Defense. In addition to weapons and supporting systems that are maintained in a state of readiness, the Ministry of Defense controls many other nuclear weapons and weapons components. Some of these weapons and components are being stored in preparation for dismantlement; others are awaiting entry into service in upgraded weapons systems; and still others are spares, rejects, or simply extra devices being maintained at field sites for a variety of reasons. In addition, warheads in various stages of assembly and disassembly are the responsibility of the Ministry for Atomic Energy.

On the order of 200 tons of plutonium and 1,200 tons of HEU are available in many forms in the successor states.[19] Most of this direct-use material is located in Russia. Some is or will be used in weapons; some is earmarked for future nuclear reactors; some is used in research activities; and much is being stored while ultimate disposition is determined. Very limited quantities are retained at facilities in Ukraine, Belarus, Kazakstan, Latvia, Georgia, and Uzbekistan. Most of the material in these six states is associated with civilian-oriented nuclear research activities.

In addition to direct-use material, Russia has a well-developed capability to manufacture equipment necessary for producing HEU and plutonium. For example, for decades it has had the capability to manufacture centrifuges, a relatively straightforward technology for enriching uranium to a level adequate for weapons.

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[19] General Accounting Office, "Nuclear Proliferation: Status of U.S. Efforts to Improve Nuclear Material Controls in Newly Independent States," GAO/NSLAD/RCED-96-89, (Washington, D.C.: General Accounting Office, March 1996), p. 3. Estimates vary on the amount and enrichment level of HEU in the FSU.

Russia, together with the United States, has the world's largest multipurpose nuclear establishment. At the same time, many of the hardware and software requirements for nuclear weapons programs overlap very directly with demands for similar technologies for nuclear power, medical isotopes, and other civilian uses considered essential to the stability of the economies of several FSU states.[20]

The capabilities of several other successor states in the nuclear technology arena also are significant. Ukraine and Kazakstan have considerable storehouses of know-how, including hands-on experience in using nuclear material and related equipment in ways that could be helpful to states seeking to make the transition to nuclear weapons status.

Finally, in Ukraine, Kazakstan, Armenia, and Lithuania, as well as in Russia, there are nuclear power reactors where spent fuel rods are stored. Some spent fuel has been collected for reprocessing at two sites in Russia (Mayak and Krasnoyarsk); and 20 to 30 tons of extracted plutonium (and more continues to be extracted) from fuel rods are stored at Mayak.[21] But most spent fuel rods remain at the reactor sites, both inside and outside Russia. For the foreseeable future, Russia is the successor state most capable of reprocessing spent fuel (and blanket material), so the fissile material could eventually be available for use in weapons.

Biological and Chemical Warfare Capability

Most of the Soviet capability related to biological warfare (BW) and chemical warfare (CW) was concentrated in Russia. Many research and production organizations were involved; and stockpiles of weapons, weapons components, and ingredients for weapons were stored at various sites under the control of the Ministry of Defense. Many of these items, particularly stockpiles of chemical agents, continue to exist.[22]

Russia is taking the initial steps toward consolidating its CW arsenal and preparing for its destruction, with the U.S. Department of Defense and its contractors participating through the Cooperative Threat Reduction program. Destruction will be required if Russia ratifies the Chemical Weapons Convention.

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[20] For example, Russia and Ukraine rely on nuclear power for 12 percent and 38 percent, respectively, of their electrical supply.

[21] Information provided by Russian nuclear reactor specialists involved in extracting plutonium from fuel rods during the committee visit to Russia in May 1996.

[22] See Roland Lajoie, "Cooperative Threat Reduction Support to the Destruction of Russia's Chemical Weapons Stockpile," pp. 1-3; Vladimir Orlov, "Chemical Weapons: Costly to Produce, Costlier to Destroy," *Moscow News*, January 26, 1996, p. 4; Milton Leitenberg, *Biological Weapons Control* (College Park, Md.: Center for International and Security Studies, University of Maryland, PRAC Paper No. 16, May 1996), pp. 3-23; and Anthony Rimmington, "From Military to Industrial Complex? The Conversion of Biological Weapons Facilities in the Russian Federation," *Contemporary Security Policy*, vol. 17, no. 1, April 1996, pp. 80-112.

However, the destruction will be very expensive, costing billions of dollars in Russia alone. Indeed, this price tag is a major reason for Russian hesitancy to ratify the convention.[23]

CW agents were produced in about one-half dozen plants in Russia in quantities comparable to U.S. production levels. These plants are now either closed or are producing chemicals for civilian uses, according to the Russian Government. Many of the most toxic chemicals produced in these plants for civilian uses will be subject to reporting requirements when the Chemical Weapons Convention is adopted.[24]

The U.S. Government has repeatedly asserted that Russia has not adequately demonstrated its compliance with the 1972 Biological Warfare Convention, which bans the production of offensive BW agents. The Russian Government denies these allegations, although it has acknowledged that there was an offensive BW program on the territory of Russia prior to 1992. In any event, it is clear that a number of facilities have either been converted to civilian activities or abandoned altogether. Some are engaged in defensive military research, as permitted by the Biological Weapons Convention.[25]

Limited BW and CW capabilities existed outside Russia, particularly in Kazakstan. BW and CW production and testing facilities were located there during Soviet times. These facilities are now closed or devoted exclusively to civilian activities, according to Kazakstani officials.[26]

Large pools of highly skilled chemical and biological scientists available in several successor states, together with the relative simplicity of facilities necessary to produce BW and CW agents, raise concerns as to the technical potential for some facilities, particularly those in Russia, to revert to military activities in the future. Also, certain civilian activities have characteristics and equipment

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[23] Discussions during the committee visit to Russia in May 1996. See also Igor Khripunov, "The Human Element in Russia's Chemical Weapons Disposal Efforts," *Arms Control Today*, July/August 1995.

[24] For the reporting and verification requirements for chemical plants not producing weapons, see Part IX of the Verification Annex (Regime for Other Chemical Production Facilities) of the Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons and on Their Destruction.

[25] Article 1 of the 1972 Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction bans biological weapons "that have no justification for prophylactic, protective, or other peaceful purposes." The *ACDA 1995 Annual Report* notes that the U.S. and U.K. continue to work with the Russian government "to ensure complete termination of the illegal BW program" (see Chapter 2, Section B of the report). See also 1996 Confidence Building Measures of the Russian Federation, which is on file with the United Nations Centre for Disarmament Affairs (Ref: 11-96/CDA/BW-III/Add.II, October 21, 1996, pp. 10-42). Discussions of various allegations concerning the Russian program are set forth in Milton Leitenberg, "Biological Weapons Arms Control," Center for International Security Studies, University of Maryland, October 25, 1995.

[26] Discussions with Kazakstani officials during the committee visit to Almaty in April 1996.

requirements similar to those for production of BW and CW agents, heightening future. Given the ease of transferring the technologies across poorly defined boundaries—either embedded in equipment, recorded in documents, or carried in the knowledge of scientists—security systems will inevitably be less than perfect in preventing the proliferation of BW and CW technologies.

Missile Technologies

The Soviet missile development and production facilities were located primarily in Russia and secondarily in Ukraine, while testing and launch facilities were sited in Kazakstan. Suppliers of components were located in almost every republic of the FSU.

Many enterprises and institutes that were involved in missile-related activities are pinning their future hopes on yet-to-be-realized opportunities in the field of space exploration, including opportunities for selling rocket and satellite components and for marketing launching and tracking equipment abroad. Several of the largest enterprises, such as the Energiya and Khrunichev enterprises in Russia and the Yuzhmash enterprise in Ukraine, have projects under way with foreign partners. Most of the missile manufacturing facilities that were the pride of the Soviet military complex remain largely intact as their directors search for new marketable products, and they retain a weapons capability that remains of concern from the viewpoint of proliferation.[27]

Conventional Weapons Systems

Military Aircraft

Production and testing facilities for military aircraft were centered in Russia and Ukraine. Military airplanes were made in other successor states as well, and component manufacturers could be found in almost every state.

Many enterprises and laboratories of the aviation complex of the FSU are trying to remain in the forefront of technology through contracts with foreign entities that enable them to retain at least a portion of their facilities in an operating state. From the western perspective, these facilities lag well behind in many technical areas because of equipment obsolescence and loss or degradation of previously elite scientific work forces. Nonetheless, the facilities deserve careful attention as their managers attempt to adapt dual-use technologies embodied in

[27] Unconfirmed reports during 1995 and 1996 suggest that aggressive enterprise directors may be seeking new outlets in China for their rockets, which has raised concerns over Russia's commitment to requirements under the Missile Technology Control Regime. See, for example, Bill Gertz, "Russia Sells Rocket Motors to China," *Washington Times*, February 13, 1995, p. 1.

machine tools, high-strength materials, electronics, optics, and other fields with military applications.

Throughout the region there is excess aircraft production capacity. Even with the most optimistic projections of the recovery of the Russian economy and success in selling aviation products abroad, this capacity is far beyond the domestic and export needs of Russia and the other successor states. Most of the institutes and enterprises of the Soviet military-industrial complex are attempting to sell their old products, as well as new innovations, in previously untapped markets throughout the world. Demands from developing countries for Russian military hardware, including fighter aircraft and supporting systems, are of special interest. While the demand for military hardware in the United States, Europe, and elsewhere has been flat or declining in recent years, during the past several years it has been reported in the press that Russian organizations have been quite successful in selling equipment abroad, particularly to China and India.[28]

Other Conventional Weapons

Almost all of the successor states have facilities for producing other types of conventional weapons, ranging from sophisticated airborne smart weapons and attack submarines to hand-carried assault guns. These activities will undoubtedly continue, although research and development efforts in Russia to enhance existing weapons systems have declined dramatically in the face of dwindling budgets.

The international arms market for Russian-origin weapons was established many years ago. Given the willingness of Russian enterprises to provide such weapons at bargain prices, demand will undoubtedly continue. However, because of competition from arms manufacturers in the West and related diplomatic pressures, Russian equipment—both old and new—will undoubtedly find its most receptive buyers in precisely those states that are of concern to the U.S. Government (e.g., submarines to Iran). While the demand for reliable and inexpensive Russian handheld weapons will continue, the market for larger items, including tanks and rockets in addition to submarines and aircraft, seems less certain.

Throughout Russia, and to a lesser extent in other countries of the region, there are large stores of surplus equipment and excess weapons for supporting military operations left over from Soviet times. Some of this equipment has been cannibalized. Some is inoperable. Some has been adapted for civilian tasks.

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[28] See "Rosvooruzheniye Expects 1996 Arms Sales to Top $7 Billion" and "Russia Competes Again for Arms Trade," both in *Moscow Times*, March 28 and April 3, 1996. Also, in July 1996 the Foreign Broadcast Information Service reported that a licensing request for production of Sukhoi-27 fighter aircraft in China was being developed. On February 3, 1997, Rosvooruzheniye told ITAR-TASS press service of plans to market 200 to 300 of the most advanced Russian weapons systems in Asia, Latin America, and the Middle East and confirmed sales of S-300 air defense missiles to Cyprus.

Almost all has been poorly maintained. Nevertheless, vehicles, radar sets, vision Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union operations are available. Many of the custodians of these stockpiles have been torn for several years between (a) profits to be gained through surplus sales or illegal diversions, and (b) obligations to preserve military capability.[29]

Other Dual-Use Technologies

Meanwhile, the factories and institutes that produced many types of military hardware are busy seeking customers for new civilian products that draw on military-oriented technologies.[30] It is difficult to identify research products of the past several years that have made the jump to marketable items without deep involvement of western firms. But even if the successor states are unable to capitalize on dual-use approaches, western countries will continue to worry that other states of proliferation concern could tap these technologies and use them for military purposes.

INTERESTS OF COUNTRIES OF PROLIFERATION CONCERN

The United States and other western countries have branded the current regimes of North Korea, Iran, Iraq, and Libya as aggressive seekers of advanced weapons capabilities that would present threats to international security. All of these countries have long histories of cooperation with the Soviet Union. Also, the rocket and nuclear capabilities of India and Pakistan are of considerable concern, and the Soviet Union and its successor states have had active ties with these countries. Other countries of the Middle East, China, and even countries of Southeast Asia and Latin America are constantly upgrading the level of sophistication in their weapons and are turning to Russia as one possible supplier of their military needs.[31]

The list of western nonproliferation concerns is headed by the possibilities of (a) the acquisition of a nuclear weapons capability by any state not now having such capability, and (b) the improvement of nuclear capabilities by states that

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[29] Discussions during the committee visit to Russia in May 1996.

[30] See, for example, L. Kosals, "Defense R&D institutes in a Changing Russia," Working Document No. 5, International Conference on Science, Technology, and Innovation Policies in Russia, sponsored by the Organization for Economic Cooperation and Development in Moscow, September 21–23, 1995.

[31] Israel is also believed to be an undeclared nuclear weapons state and is not a party to the Non-Proliferation Treaty. However, the U.S. Government has not been concerned about Israel's weapons capability in the same way as these other countries.

already have embryonic weapons programs. As previously noted, the principal efforts to help contain nuclear and other dangerous materials and technologies in the

As for rocket technology, the Persian Gulf war centered attention on Scud missiles and other rudimentary delivery systems that could draw on early Soviet technologies. While such technologies have become widely available from China, continuing technical contributions from FSU states to countries seeking primitive or advanced missile capabilities could be very significant.

The ingredients for BW and CW weapons are relatively simple for determined parties to acquire. Packaging these ingredients into terrorist weapons is not complicated for scientists and engineers, even though they may have little experience in weaponry. Of course, experienced hands will reduce the hazards to the terrorists themselves while improving weapons efficiency. Turning such weapons into effective military weapons with significant destructive power on the battlefield is much more complicated, and in this area the skills and experience of Russia and other states of the FSU could be particularly helpful, indeed decisive.

Dual-use technologies of many types are becoming commonplace throughout the world. Countries attempting to develop either weapons of mass destruction or advanced conventional weapons usually draw heavily on such technologies for both weapons components and supporting systems. Russia has dual-use items that can respond to many military requirements as well as civilian needs. As the previous security wraps are removed from advanced Russian military developments, many high-performance items may become available.

Many industrial facilities of importance to the military-industrial complexes in China, North Korea, and the Middle East trace their origins to Soviet designers and engineers who participated in Soviet technical assistance activities targeted in these areas. Now as these plants age and modernization and replacement equipment is in order, the countries sometimes turn again to Russia for assistance in rehabilitating the facilities. Critical spare parts from Russia can often be important for the continued viability of the plants. At the same time, the level of technological literacy is on the rise in many developing countries. The strengthened cadres of well-trained technical personnel throughout the world serve to improve the capacity of Third World countries to absorb sophisticated technologies that are available from Russia, Ukraine, and other FSU countries.

SALES AND SMUGGLING OF SENSITIVE ITEMS

There are several routes of transfer of sensitive commodities from the FSU to countries of proliferation concern. First, governments throughout the world assert the right to sell arms and advanced technologies, often pointing to U.S. arms sales, which are far larger than the sales of any other country, in fending off criticisms of controversial transactions. Indeed, governments have different perspectives on the appropriateness of certain sales of sensitive items that are not

explicitly prohibited by international agreements. In times of economic hardship the Russian Government may encounter greater difficulties in controlling commercial aspects of foreign sales of sensitive equipment than does the U.S. Government. Thus, disagreements between governments may ensue over the appropriateness of specific sales that are either encouraged or authorized by the Russian Government. The proposed sales by Russia of nuclear centrifuge technology to Iran and of cryogenic rocket technology to India are cases in point.

Second, in addition to sales orchestrated by governments, many enterprises in several successor countries are interested in entering into their own international sales and barter arrangements. Generally, governmental authorities are aware of major transactions, although in some cases enterprises may proceed with a sale knowing that questions to clarify procedures would only lead to bureaucratic delays.

Third, smuggling activities are an obvious pathway for diversion. As noted, the thefts of small amounts of direct-use nuclear material in Russia have been of major concern, given the critical importance of direct-use material in the spread of nuclear weapons capabilities.

Finally, the rise in organized crime within and outside the FSU has sensitized the entire international community to the possibility of significant contraband activities. There has been a rapid increase in the number of representatives of foreign organizations now resident in the FSU. Many represent well-known organizations with reputations for adherence to laws and high standards of business ethics, but others operate behind unmarked closed doors.

Most of the governments of the FSU are gradually accepting new approaches to safeguarding sensitive materials and equipment using physical protection and detection techniques. This new emphasis does not mean that reliability of personnel can be disregarded. Rather, the governments understand that technical systems are very important for controlling sensitive items—whether they be items passing through exits from research and production facilities or packages transiting border crossing points. Such increased reliance on physical methods, as an important complement to the screening of employees, closely parallels western approaches.

To assure the security of commodities and technologies of concern, significant upgrading of controls is necessary. The governments of the successor states of the FSU recognize this need. This provides new opportunities for productive bilateral cooperation among specialists in the fields of materials protection, control, and accountability and export control.

IMPLICATIONS FOR COOPERATIVE PROGRAMS

The implications of the foregoing developments in the FSU for bilateral cooperation in areas that affect the vital national security interests of all participating countries—and specifically cooperation in MPC&A and export control—are un-

certain at best. The current political leaders in Russia, Ukraine, Belarus, and Kazakstan recognize the importance of improved MPC&A and export control systems. They are aware of the vast quantities of inadequately protected items with military significance located in the region—particularly in Russia. They acknowledge the deficiencies in current regulatory and security systems and recognize the benefits of engaging U.S. specialists in helping to upgrade their systems.

However, the leaders in these countries could easily change, and new personalities may not have the same outlook toward the importance of cooperation in such sensitive fields. Indeed, future leaders could terminate bilateral programs abruptly. Thus, if these cooperative programs are effective, the importance of moving forward with them while the political doors are open is clear. Indeed, the deeper the base of support for cooperation in the four successor countries—support nurtured through working side by side—the greater the survivability of the programs in the midst of rapidly evolving political forces in the countries.

4

Protection, Control, and Accountability of Direct-Use Material

THE PROLIFERATION RISK FROM LEAKAGE OF DIRECT-USE MATERIAL

Acquiring direct-use material—separated plutonium or unirradiated highly enriched uranium (HEU)—is a principal technical barrier for any nation or group seeking to develop nuclear weapons.[1] Several *kilograms* of plutonium or several times that amount of HEU are sufficient to make a nuclear weapon, with the quantity depending on the composition of the material, type of weapon, and sophistication of the design.[2] Estimates put the current inventory of direct-use material in the former Soviet Union (FSU) at about 200 *tons* of plutonium and about 1,200 *tons* of HEU, much of which is not incorporated into nuclear weapons.[3] Almost all of this material is in Russia. Other FSU states have much smaller

[1] Many other commodities and technologies are also required to construct a weapon, but most of these items probably can be more readily obtained than direct-use material.

[2] For example, the exact amount of HEU depends on its level of enrichment. Much more HEU would be needed for a device if the material were only enriched to the level of 20 percent rather than 90 percent. Nonetheless, it is possible to fabricate a nuclear explosive device with 20 percent material. With natural uranium (0.7 percent) or with common reactor fuel (3 to 4 percent), a complex process would be required to reach an enrichment level for use in a weapon. The United States requires the highest level of security protection at buildings classified as Category I, that is, where 2 or more kilograms of plutonium or 5 or more kilograms of any type of HEU are located.

[3] General Accounting Office, "Nuclear Proliferation: Status of U.S. Efforts to Improve Nuclear Material Controls in Newly Independent States," GAO/NSLAD/RCED-96-89 (Washington, D.C.: General Accounting Office, March 1996), p. 3. Estimates vary on the amount and enrichment level of HEU in the FSU.

Throughout this report all references to tons are to metric tons. One metric ton is 2,205 pounds.

stocks, totaling less than one-half ton, but these quantities are still significant.[4] Some of this material is increasingly vulnerable to theft or diversion.

There is an urgent need to improve controls over direct-use material in the countries of the FSU. Acquiring substantial quantities of either HEU or plutonium could greatly simplify the efforts of a nation to obtain or augment a nuclear weapons capability. Kilogram quantities of HEU could be used by groups with relatively limited technical capability to construct a crude but effective nuclear device. And terrorists could disperse into the environment modest amounts of plutonium or other radioactive materials, which could cause substantial damage and societal disruption.

In Russia direct-use material is found in many forms at a variety of military and civilian facilities[5] that fall under the jurisdiction of several ministries, agencies, and institutes. For its purposes, the U.S. Department of Energy (DOE) considers that the material is distributed among five "sectors":[6]

1. Nuclear weapons, which are largely under the custody of the Ministry of Defense (MOD). These weapons, which are not included in the scope of this study, are currently deployed or stored at fewer than 100 sites, down from over 500 in the late 1980s.[7]

2. Material in the Ministry of Atomic Energy (MINATOM) defense complex, such as the weapons design institutes at Arzamas-16 and Chelyabinsk-70. Like DOE in the United States, MINATOM is responsible for production, assembly, and disassembly of nuclear warheads. An estimated 2,000+ warheads are being dismantled each year as a result of U.S.-Russian arms reduction agreements. This sector thus has large amounts of direct-use material and its inventories are growing. One recent study estimates that 15 tons of plutonium and 45

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[4] Estimate based on committee discussions with officials at selected FSU institutes. Latvia, Uzbekistan, and Georgia also have small quantities of HEU. U.S. bilateral programs with these countries are beyond the scope of this report.

[5] In this report the term "facility" is used to denote a collection of buildings and/or structures that serve a common purpose. A facility may contain more than one building, and in some cases two or more facilities may be grouped at one site, such as Tomsk-7, which has at least six.

[6] "Unified US-Russian Plan for Cooperation on Nuclear Materials Protection, Control, and Accounting (MPC&A) Between the Department of Energy Laboratories and the Institutes and Enterprises of the Ministry of Atomic Energy (MINATOM) Nuclear Defense Complex," Department of Energy, September 1, 1995, pp. 7-8.

[7] John Deutch, Director of Central Intelligence, "The Threat of Nuclear Diversion," testimony to the Permanent Subcommittee on Investigations of the Senate Committee on Government Affairs, March 20, 1996, p. 8. The Soviet Union had withdrawn its tactical nuclear weapons from Eastern Europe by 1991, and, as a result of agreements reached in 1994, Russia has become the heir to all nuclear weapons on the territory of the FSU. All nuclear warheads were transferred to Russia from Kazakstan in 1995 and from Ukraine and Belarus in 1996.

tons of HEU are now being transferred annually from MOD to MINATOM facilities.[8]

3. Material in the MINATOM civilian institutions, such as the Institute of Physics and Power Engineering in Obninsk, the plutonium reprocessing facility at Mayak, and the Luch Scientific Production Association in Podolsk.[9] Many of these facilities are devoted to research and development on nuclear power reactors, along with producing power reactor fuel and other nuclear materials for civilian applications. Although the amounts of direct-use material in this sector are smaller than in the defense sector, the quantities are still significant as a proliferation risk.

4. Material at civilian research facilities outside MINATOM, such as the Kurchatov Institute of Atomic Energy, the Dubna Joint Institute of Nuclear Research, and the Moscow Engineering Physics Institute. In most cases the amounts of material at these facilities are relatively small, but Kurchatov has several tons.

5. Material for marine propulsion applications in submarines, surface ships, and civilian icebreakers. The facilities have stocks of HEU at various levels of enrichment.

Outside Russia, all known stocks of direct-use material are in civilian facilities. Thus, in the four categories outside the Russian MOD, direct-use materials are stored at an estimated 80 to 100 facilities in the FSU.[10]

Both HEU and plutonium represent serious proliferation risks. HEU is of particular concern because, unlike plutonium, it can be used in a simple gun-type device.[11] HEU can be blended down into low-enriched uranium (LEU) and used as fuel in nuclear power reactors.[12] The United States has adopted this HEU-to-LEU approach, agreeing in 1992 to buy 500 tons of HEU from dismantled Russian weapons which is being converted to LEU.

During the Soviet Union era, the security over all direct-use material was not in question, reflecting the formidable police power of the state and the loyalty of

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[8] G. Allison, O. Cote, R. Falkenrath, and S. Miller, *Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Materials* (Cambridge, Mass.: The MIT Press, 1996), p. 21.

[9] Unlike the United States, which now maintains a strict separation between military and commercial nuclear activities, in the Soviet Union the same facilities sometimes performed both kinds of work. Commercial nuclear research thus also takes place in facilities that are usually counted as part of the MINATOM defense sector.

[10] "Report on Control and Accountability of Materials Related to Weapons of Mass Destruction in the Former Soviet Union," Department of Defense, June 1, 1995, p. 2. The estimate of 80 to 100 facilities is used for both Russia and the entire FSU in different reports.

[11] J. Carson Mark, "Explosive Properties of Reactor Grade Plutonium," *Science and Global Security*, vol. 4, 1993, pp. 111-128.

[12] In contrast, converting plutonium to a form that is unsuitable for weapons use is an economically less attractive and technically more challenging task.

the managers, soldiers, and workers in the Soviet nuclear complex. The security system relied on "a command economy, a closed society, a controlled society, and extensive surveillance of personnel by the KGB."[13] The very existence of many closed cities was considered a state secret, and they were surrounded by perimeter fences and numerous guard posts. "The physical protection programs [relied] more on manpower than on technical systems. The security system ultimately depended on a responsible, competent, and well-disciplined establishment, and well treated and loyal personnel."[14] The civilian portion of the Soviet nuclear complex was also subject to strict security, although not as exacting, and again it focused heavily on controlling personnel.

The Soviets maintained accounting systems for material in MOD and MINATOM weapons inventories to complement the system of personnel security and physical protection, but the accounting efforts apparently did not extend beyond the maintenance of paper records that were not always complete or easily accessible. There is also anecdotal evidence that some facility managers maintained stocks of material off the books to ensure that quotas for producing material would be met. In addition, as in the nuclear complex in the United States, the nature of the process of producing and handling direct-use materials results in uncertainty about the exact quantities of material that a facility actually possesses. Measurements are particularly difficult when material is in process, held up in pipes and vessels, or otherwise inaccessible.[15]

According to DOE, there is no central inventory of all direct-use material in Russia.[16] Although individual facilities do have inventory data, much of the information is reported to be incomplete or inadequate. Inventories of shipments of materials between facilities may also be complicated by differences in measuring instruments and sampling procedures among facilities. Not surprisingly, the best data are available on high-quality materials, while information on scrap, residues, or materials in process is generally poor. The U.S. intelligence community believes that "the Russians may not know where all their material is located."[17]

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[13] John P. Holdren, Chairman, Panel on U.S.-FSU Cooperation to Protect, Control, and Account for Weapons-Usable Nuclear Materials, testimony to a joint hearing of the Permanent Subcommittee on Investigations, Senate Committee on Governmental Affairs, and Subcommittee on Europe, Senate Foreign Relations Committee, August 23, 1995.

[14] David Osias, National Intelligence Officer for Strategic Programs, "Security of Nuclear Weapons and Weapons-Usable Material in FSU," testimony to the Senate Foreign Relations Committee, August 22, 1995.

[15] For example, in February 1996 DOE released estimates of cumulative inventory differences in the United States of 2.8 metric tons of plutonium over a 50-year period (U.S. Department of Energy, *Plutonium: The First 50 Years*, p. 52).

[16] DOE responses to the committee's questions, October 23, 1995.

[17] John Deutch, Director of Central Intelligence, "The Threat of Nuclear Diversion," testimony to the Permanent Subcommittee on Investigations of the Senate Committee on Government Affairs, March 20, 1996.

Upon the breakup of the Soviet Union, the non-Russian states started essentially from scratch to establish systems to control and account for nuclear materials. In some cases, senior officials of new ministries initially were not aware of the existence or amount of direct-use material in their keeping. In addition, and particularly in the case of Kazakstan, much of the experience in MPC&A was tied to Soviet requirements generated in Moscow. Responsibility for implementing MPC&A systems was largely in the hands of specialists from Russia, some of whom returned to Russia in the early 1990s. While some elements of the old physical protection systems (e.g., fences, alarms), even if inadequate, could be transferred to the new owners and operators of facilities, control and accountability systems at both the facility and the national levels had to be constructed.

More generally, the future of the FSU nuclear research and production complex is uncertain. The end of the Cold War and the prospect of significant nuclear arms reductions have reduced the roles for many facilities. MINATOM has instructed its defense-related and civilian facilities to become more self-supporting and find other sources of income beyond government funds. Some laboratories and storage buildings are deteriorating. There is little or no money for maintenance, purchase of equipment, or, sometimes, payment of salaries. Many workers are leaving to pursue other jobs.

In such circumstances, the vulnerabilities of the security systems present temptations for disaffected or desperate workers and reduce the prospects that thefts will be detected. In March 1996, John Deutch, director of the Central Intelligence Agency, testified that

> a comprehensive examination revealed that none of these (non-MOD) facilities in Russia or other newly independent states had adequate safeguards or security measures by international standards for weapons-usable material. . . . The chilling reality is that nuclear materials and technologies are more accessible now than at any other time in history—due primarily to the dissolution of the former Soviet Union and the region's worsening economic conditions.[18]

By most accounts, the nuclear weapons in the MOD system remain under good control, although concern for their security is growing among western governments. The farther one moves from intact warheads, in MOD and especially in MINATOM and in the rest of the FSU, however, the more vulnerable the material appears to be.[19]

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[18] Ibid.

[19] Ibid. As noted, the MOD complex is outside the scope of this study. Deutch testified that: "We believe the likelihood of the loss of a nuclear weapon is still slight today. But the threat from within the Russian military and a deteriorating economy mean that this judgment could change rapidly."

To date, despite hundreds of reports, there are only a few known cases of thefts or diversion of direct-use material.[20] The amounts involved in these cases have been quantities of material far smaller than what would be required to make a nuclear weapon. And none of the thefts was from a nuclear weapons storage facility. Nonetheless, after initial reluctance to acknowledge the shortcomings in MPC&A, Russian officials have now called for improvements in the systems to protect direct-use and other types of nuclear materials.[21]

COMPONENTS OF MPC&A

MPC&A should be one of the core elements of a national system of safeguards and security that the international community expects all countries possessing nuclear materials to establish. Such systems are designed to protect the material against theft or diversion and to detect such events if they occur. Briefly,

1. *Physical protection* systems are "designed to detect any unauthorized penetration of barriers and portals, and to respond with immediate investigation and use of force if necessary."[22] The systems should delay perpetrators long enough for guards and, if necessary, additional forces to respond. Physical protection measures are generally the most visible and pervasive components of a safeguards systems. Fences, multiple barriers to entry, limited access points, alarms, and motion detectors are all examples of elements of a physical protection system in addition to guards.

2. *Material control* systems are designed to "prevent unauthorized movement of special nuclear materials and to detect promptly the theft or diversion of the material should it occur."[23] These systems may include portal monitors and other devices to control egress from storage sites; authorized flow paths, storage locations, and secure containers for material; and seals and identification codes that make it possible to readily verify the location and condition of material. Good material control may also assist with physical protection.

3. *Material accountability* systems are designed "to ensure that all material of interest is accounted for, or to measure the loss of any, and to provide information for follow-up investigation, within error limits imposed by the process and

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[20] In a meeting with the committee during its visit to Moscow in May 1996, a senior MINATOM official said that there had been 23 cases of thefts and attempted thefts of nuclear-related materials from MINATOM facilities during 1993 and 1994 but that only three were successful. According to the same official, there had been no thefts or attempted thefts in 1995 and 1996.

[21] No theft of direct-use material is known to have occurred in 1995 or 1996, but it is not known if this is the result of improved security, more skillful thefts, or reluctance of officials to disclose thefts.

[22] National Research Council, *Material Control and Accounting in the Department of Energy's Nuclear Fuel Complex* (Washington, D.C.: National Academy Press, 1989), p. 38.

[23] Ibid., p. 41.

by instruments."[24] These include both traditional inventory systems and an array

Integral to all three of the above systems is personnel reliability, which includes "security screening, indoctrination, training, and some personnel records functions. . . ."[25] It may also include both procedures ensuring that no single worker is left alone in sensitive areas (the two-man rule) and limits on access to certain facilities, which can be part of material control procedures as well.

The design of an MPC&A system rests on fundamental principles of "graded safeguards" and "defense in depth" against a spectrum of threats. The principle of graded safeguards reflects the belief that the effort and resources devoted to improving MPC&A must be commensurate with the particular risks to material at any given facility. Defense in depth incorporates redundant and diverse layers of defense to increase the difficulty of penetration and to guarantee that the failure of any single layer will not result in a major loss.[26]

In accordance with these principles, MPC&A systems should be designed to protect against a range of threats. The threats may be external—for example, break-ins or attacks by individuals or groups such as terrorists, or internal, such as thefts by one or more employees with access to the material. Insiders might also work with an outside group so that a facility could be subject to a combined internal and external threat. Table 1.4 in the Executive Summary outlines the basic features of an MPC&A system.

During the time of the Soviet Union, external threats were the primary concern because officials were confident of their control over personnel.[27] During the committee's visits to Russia, Ukraine, Kazakstan, and Belarus, a number of officials and facility managers remarked that they still see the largest threat as coming from outsiders, either from terrorists intent on theft or sabotage or, in the worst case, from large-scale civil unrest. Western experts and many in the FSU, however, consider the internal threat from employees who believe there is a market for nuclear material to be underestimated. The known thefts and attempted thefts to date have been carried out by insiders acting alone or in small groups. An effective MPC&A system must be able to cope with a range of threats, with each potential threat triggering an appropriate level of protection.

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[24] Ibid., p. 42.

[25] Ibid., p. 38.

[26] DOE answers to committee questions, October 23, 1995.

[27] "Set up under Soviet rule for a strictly regimented closed society worried only about external threats, the security often amounts to little more than barbed wire fences and armed guards, providing scant protection against insiders and their accomplices who hope to get rich by smuggling out nuclear materials for sale on the black market . . ." (testimony of Lawrence Gershwin, Central Intelligence Agency, before the House Committee on Appropriations, DOD Appropriations for 1993, Part 5, May 6, 1992, p. 498).

Identification of relevant and appropriate threat scenarios is the first step in the cost-benefit analysis of physical protection improvements. The scenarios provide the "Design Basis Threat" for assessing, correcting, and monitoring the vulnerabilities of a facility. A critical aspect of this process is ensuring the security of information about vulnerabilities. Such details, which are considered classified information by governments, would provide an "instruction book" for terrorists. Control and accounting systems for direct-use material tend to be more generic and less affected by specific threat scenarios, although some material control equipment may also serve specific physical protection roles and the systems certainly contribute to the overall physical protection of the material.

All nations in possession of nuclear materials have some form of national MPC&A system, although national programs and standards vary significantly. The parts of the system related to material control and accountability are also subject to international standards as part of a country's nonproliferation obligations. But these "safeguards" are intended to thwart undisclosed diversion by the state itself rather than prevent theft and to provide "timely warning" that such diversion has occurred. The standards provide a baseline against which to measure national material control and accountability systems; and FSU governments seem to find it politically desirable to accept and work toward internationally accepted norms.

INTERNATIONAL CONTEXT FOR MPC&A SYSTEMS

National MPC&A programs take place in the context of a number of international treaties and agreements designed to control the proliferation risk posed by direct-use materials while still permitting peaceful nuclear activities. The nuclear Non-Proliferation Treaty (NPT) divides nations into three groups: five nuclear weapons states (NWSs—China, France, Great Britain, Russia, and the United States), the remaining nonnuclear weapons states (NNWSs), and non-signatories.[28] NNWSs that are parties to the NPT are required to accept full-scope safeguards by the International Atomic Energy Agency (IAEA). "Full-scope" safeguards apply to "*all* nuclear materials in all peaceful nuclear activities within their territory or under their control." They consist of "a system of procedures involving material control and accountancy, containment and surveillance, and verification (including on-site inspections at declared facilities) that are implemented through agreements between the IAEA and individual countries." NNWSs that are not parties to the NPT may also enter into safeguards agreements with the

[28] Three other countries, India, Pakistan, and Israel, are generally considered to have acquired nuclear weapons capability, but none has acknowledged this publicly. None of the three is a party to the NPT. A fourth, South Africa, acquired a few nuclear weapons but abandoned its program and destroyed its stockpile in the early 1990s. It became a party to the NPT in 1991.

IAEA, and most have done so for at least some of their facilities, largely as a result of help from the United States.[29]

By contrast, the NWSs are not required to accept IAEA safeguards, although all five have signed "voluntary offer" agreements under which they have agreed to subject some of their facilities to such safeguards. Currently, no facilities in Russia are under IAEA safeguards, although there are continuing discussions of possible monitoring for portions of the disposition of the excess fissile materials resulting from arms reduction agreements. In addition, Soviet/Russian specialists have worked for the IAEA and thus have acquired knowledge about and experience with the international system.

The other successor states with nuclear facilities and material, as NNWS parties to the NPT, are in various stages of developing safeguards agreements with the IAEA and implementing the associated accountability requirements to cover their entire nuclear programs, which are limited to peaceful activities. They also have cooperative programs with the United States and several other governments to assist in this process. Kazakstan, for example, is working closely with the IAEA in creating its MPC&A system, in part because it wants to establish its credentials as a responsible nuclear trading partner so that it can continue to export uranium and beryllium.

Unlike material control and accountability systems that are required for NNWSs by international agreements and that are aimed at detecting diversions of nuclear material by governments, the responsibility for physical protection of nuclear materials "rests entirely with the government of the State."[30] Recognizing, however, that "it is not a matter of indifference to other States whether and to what extent that responsibility [for national physical protection] is being fulfilled,"[31] the IAEA periodically issues updated guidelines for countries to follow in implementing their internal MPC&A programs. But the guidelines are purely advisory. The only relevant international accord concerning the physical protection of nuclear materials against theft—the 1980 Convention on the Physical Protection of Nuclear Material—covers nuclear material for peaceful purposes while in international transport. However, it has neither verification nor enforcement provisions.[32] Thus, efforts to improve physical protection do not have a strong international standard against which to measure goals or progress. The United States and other industrialized states have detailed regulatory provisions establishing standards for MPC&A. These, together with the IAEA's advisory

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[29] Office of Technology Assessment, *Nuclear Safeguards and the International Atomic Energy Agency* (Washington, D.C.: U.S. Government Printing Office, 1995), p. 27.

[30] Hans Blix, "Preface," in *The Physical Protection of Nuclear Material*, INFCIRC/225/Rev. 3, (IAEA, Vienna, December 1989).

[31] Ibid.

[32] U.S. Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements: Texts and Histories of Negotiations* (Washington, D.C.: U.S. ACDA, 1990), pp. 301-313.

guidelines, form a de facto benchmark for assessing the adequacy of controls in the Soviet Union.

Today, Russia, Ukraine, Belarus, and Kazakstan are undertaking efforts to improve protection of direct-use material at their principal facilities. But the task is enormous, and none of the countries has adequate funds or personnel to do the task on its own. Given the proliferation risks these materials represent, western and other governments have found it in their own national interests to offer assistance. The United States has undertaken a significant program of cooperation with Russia, as well as with Belarus, Kazakstan, and Ukraine, to bring the level of security for their direct-use materials up to international standards. The IAEA and the G-7 governments are also engaged in the effort, although on a much smaller scale.

SCOPE AND OBJECTIVES OF U.S. COLLABORATION WITH RUSSIA, UKRAINE, BELARUS, AND KAZAKSTAN

Russia

U.S.-Russian discussions on MPC&A cooperation began in late 1991, shortly after the U.S. Congress passed the Nunn-Lugar legislation. The primary focus of the Nunn-Lugar legislation and the activities of the U.S. Department of Defense (DOD) with Russia during the first years of cooperation was dismantlement, transportation, storage, and safeguarding of weapons themselves. But DOD recognized the need for MPC&A upgrades as well and in 1993 finally signed an agreement with MINATOM on developing national MPC&A systems and improving controls over civilian nuclear material. In 1994, prompted by its success in scientific collaborations with Russian institutes in other areas, DOE initiated additional efforts to expand collaboration to MPC&A.

The principal U.S. effort in Russia now consists of two complementary programs administered by DOE: government-to-government, which was funded by DOD under the Cooperative Threat Reduction (CTR) program through fiscal year 1995 and thereafter by DOE; and lab-to-lab, initiated by DOE in 1994 and funded with DOE resources from the outset. Under a third related program on regulatory support, the U.S. Nuclear Regulatory Commission and DOE are assisting Russia in developing and implementing a stronger national regulatory structure for MPC&A. Coordination of U.S. involvement in these programs is provided by an interagency group, established in 1994 and headed by the National Security Council.

The government-to-government program in Russia is based on the 1993 U.S.-Russian agreement and several subsequent implementing agreements and amendments. Those agreements identify the facilities that will participate and establish the roles and responsibilities of the participating organizations.

But the agreements did not immediately dispel fears and suspicions over

motivations that had built up over many decades. While desiring collaboration, MINATOM nonetheless was reluctant to provide information and access to facilities that the United States considered critical for cooperation.[33] Other factors delaying implementation were the needs to establish a complicated array of bilateral agreements that could serve as the formal frameworks for activities in Russia, to adjust organizational responsibilities and interagency procedures in the U.S. Government, and to adapt DOD financial regulations and procurement procedures to these unique bilateral programs. "Buy America" requirements, and the attendant lengthy procurement process, also delayed the program. These conditions were to be met at a time when political turmoil abounded in Russia, with repercussions in Washington—problems that also would arise in the other successor states of concern. During the first few years, the effort was also complicated by the fact that, although the program was carried out by DOE, it was funded and managed by DOD. Progress was slow at the beginning, and there were few concrete results for the first two years.

In part to circumvent the difficulties of implementation in the government-to-government program, and also to take advantage of the potential to build trust more readily through direct contacts among scientists who share common knowledge of and appreciation for nuclear security issues, DOE's national laboratories and their counterpart Russian institutes initiated the lab-to-lab approach for MPC&A collaboration. Contacts between scientists from U.S. and Soviet weapons laboratories had begun in the waning days of the Cold War. Those contacts increased in 1992 and 1993 with reciprocal visits and discussions of possibilities for pursuing direct collaboration. In April 1994, DOE approved a proposal from Los Alamos National Laboratory to extend the successful U.S.-Russian scientific collaborations to include joint work on MPC&A. Los Alamos and Arzamas-16 signed the first umbrella contract laying out the administrative, financial, and legal arrangements necessary to expedite the implementation of subsequent specific program-oriented contracts. Five other U.S. laboratories (Sandia National Laboratories, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and Brookhaven National Laboratory) soon joined in the lab-to-lab efforts.

Each activity is conducted with DOE approval and in coordination with the U.S. Department of State, but the lab-to-lab program has offered more flexibility and has been spared some of the administrative hurdles to implementation that the government-to-government program encountered. Today, the two programs are proceeding on parallel tracks and are in many respects indistinguishable.

[33] In a separate but related development, Presidents Yeltsin and Clinton agreed at their September 1994 summit to an exchange of information about aggregate stockpiles of nuclear weapons, stocks of fissile materials, and their safety and security. The negotiations to implement that exchange have not yet been completed. Certainly, the information provided by such an exchange would be a useful confidence-building measure for efforts to improve MPC&A in Russia and should also provide information relevant to a national inventory of direct-use material.

However, DOE considers it important to keep both channels in place, lest administrative problems in one area undercut progress in the other.

In addition to the lab-to-lab and government-to-government programs, the United States has sought to build other cooperative channels. The U.S. Nuclear Regulatory Commission, in close cooperation with DOE, has been working since 1993 to improve nuclear safeguards at the national and facility levels in the FSU. A 1995 agreement between DOE and Russia's nuclear regulatory agency, Gosatomnadzor (GAN), identified new areas for cooperation, including development of national regulations, a national nuclear material control and accountability system, and MPC&A assistance at GAN-regulated facilities.

The first significant result of joint MPC&A efforts in the FSU under the lab-to-lab program was the work at Building 116 at the Kurchatov Institute of Atomic Energy in 1994. At a time when U.S. specialists were still trying to gain access to other Russian facilities, major improvements were made at Building 116 in just five months. The upgrades were installed as a pilot project to demonstrate the MPC&A approach and to showcase the potential of Russian-built equipment. Many government officials in both countries view the success of that demonstration as the true beginning of the cooperative process. From the point of view of gaining full support from MINATOM, the joint MPC&A demonstration at Arzamas-16 early in 1995 was equally critical in giving the cooperative program momentum. In April 1995, the Minister of Atomic Energy ordered the entire demonstration moved to his office at MINATOM headquarters in Moscow, where he personally showed it to hundreds of Russian officials.

The fundamental objective for the collaborative MPC&A program in Russia is "to apply the technical capabilities and expertise of the U.S. and Russian laboratories, institutes, and enterprises to reduce the risk of nuclear proliferation, a problem that is vital to the national security of both countries."[34] The technical approaches in the various Russian institutions participating in the government-to-government and lab-to-lab programs are generally the same, with each activity modified as necessary to take into account the state of the concerned facility, the available funds from both sides, and the seriousness of the threat of leakage. The immediate objective is "to enhance, through U.S.-Russian technical cooperation, the effectiveness of MPC&A in Russian nuclear facilities that process or store highly enriched uranium and plutonium."[35]

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[34] Joint US-Russian MPC&A Steering Group, "Unified U.S.-Russian Plan for Cooperation on Nuclear Materials Protection, Control, and Accounting (MPC&A) Between Department of Energy Laboratories and the Institutes and Enterprises of the Ministry of Atomic Energy (MINATOM) Nuclear Defense Complex," September 1, 1995, p. 5.

[35] Ibid. These enhancements are directed primarily at three of the four components of an overall national system of safeguards and security—that is, physical protection, material protection, and material accounting. At present, DOE does not consider the fourth element—personnel reliability—a separate priority for the U.S. cooperative program.

In making these enhancements, DOE utilizes both "horizontal" and "vertical" approaches. With a horizontal approach, a particular element of an MPC&A system is selected and then implemented at multiple facilities. For example, "radiation-based portal monitors might be chosen for implementation at many facilities as soon as possible, to fill a recognized need for enhanced entry/exit control."[36] By contrast, a vertical approach would select a particular facility and then implement all the necessary elements of an MPC&A system there. In principle, the current program uses both approaches, although to date most of the efforts can best be described as horizontal.

The specific goal of the current program in Russia is to have initial MPC&A upgrades completed at all non-MOD facilities with direct-use material by 2002.[37] As mentioned earlier, as of summer 1996, agreements were in place for cooperative activities at many facilities. DOE estimates that the agreements cover about 90 percent of the Russian facilities known to contain direct-use material but not all of the buildings at those facilities.[38]

The six U.S. national laboratories involved in the programs, as well as the Nuclear Regulatory Commission, have undertaken a wide variety of projects staffed by multilaboratory teams to implement these goals. For example, Sandia National Laboratories, which has principal responsibility for physical protection technology for the United States, has provided training in basic physical protection system design that covers the technical aspects of detection, delay, and response.[39] At the Machine Building Plant in Electrostal, the cooperative program is providing new portal monitors, metal detectors, cages, and other physical protection equipment.

Upgrading physical protection at this and other facilities is difficult because under the Soviet system the integrity of individual buildings was not given a high priority. Hence, buildings often have many windows and other features considered vulnerable by western physical protection standards. Officials at the Institute of Physics and Power Engineering in Obninsk, for example, told committee members that a window overlooking a critical assembly area was much more vulnerable than they had previously thought. The viewing area will be redesigned as a result of the new assessment. To help facilities address such problems, Sandia and Lawrence Livermore national laboratories are training Russian personnel to use a vulnerability assessment computer program called ASSESS.

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[36] Ibid., p. 9.

[37] In most cases a full suite of initial upgrades will be in place. In some others, particularly in buildings where cooperation may be delayed for reasons of security or sensitivity, the upgrades should nevertheless be well on their way to completion. In all cases the Russian counterparts should be committed and should have the capability not only to ensure that the upgrades are complete but also to maintain their operation as designed.

[38] Briefing of committee staff by DOE representative, August 1996.

[39] "Delay" refers to slowing perpetrators until a response team arrives. (See also Table 1.4 in the Executive Summary.)

Computerized material control and accountability systems are planned at Kurchatov Institute, experts from Los Alamos are working with Russian computer programmers to implement a system by which the various measurement devices will feed data into a central system so that the information for keeping accurate material balances can be easily updated, collated, and maintained. Similarly, U.S. laboratories are working with the Luch Scientific Production Association to design a plan for undertaking a complete inventory of direct-use material. While institute officials claim they know the whereabouts of all direct-use material, a full inventory nonetheless is a difficult task because some material has been at the facility in uncertain conditions for decades.

At Obninsk, the stocks include 70,000 to 80,000 small metal disks that contain a total of approximately seven tons of plutonium and HEU and are used for experimental work on critical assemblies. Oak Ridge National Laboratory is leading an effort to place bar codes and seals that can be read by the new computerized inventory system on the containers for the disks. The eventual goal is to have bar codes on each disk, but that task will take several years.

Activities in Ukraine, Belarus, and Kazakstan

In Ukraine, Belarus, and Kazakstan, the United States has instituted cooperative approaches similar to those undertaken in Russia. Organizationally, the MPC&A programs in the other states are simpler, with the government-to-government approach providing ready access to facilities and people. Also, in Ukraine, Belarus, and Kazakstan, a single civilian ministry or state committee has total responsibility for nuclear regulatory activities.

As previously stated, these countries face a particular challenge as a result of the Soviet legacy. Under the Soviet system, much of the responsibility for MPC&A was in the hands of ministries and individuals in Moscow. Consequently, the dissolution of the Soviet Union left many facilities in Belarus, Kazakstan, and Ukraine without the experience and expertise necessary to develop adequate MPC&A systems.

Ukraine

A small but significant portion of the Soviet nuclear program was located on Ukrainian territory. While Ukraine transferred the last of its nuclear weapons to Russia in June 1996, its nuclear power plants and research facilities continue to store spent fuel and direct-use material. Ukraine has no plutonium but has HEU at the following facilities:

- *Kharkiv Institute of Physics and Technology*—The institute conducts nuclear research, although at present its accelerator is shut down because of a lack of funding. The institute stores about 70 kilograms of HEU.

• *Kiev Institute of Nuclear Research*—The institute's research reactor has been shut down since 1994, but the institute stores both fresh and spent fuel, including direct-use material up to 90 percent enrichment.

• *Sevastopol Institute of Nuclear Energy and Industry*—The institute's reactor has been shut down, but the institute stores both fresh and spent fuel.

In addition, Ukraine has five nuclear power plant sites at Chernobyl, Khmelnitsky, Rovno, South Ukraine, and Zaporozhye, with a total of 15 operating units at these sites. Most of the spent fuel from these plant sites is currently stored on-site. For reasons discussed below, the U.S. collaborative effort with Ukraine has been expanded beyond just those facilities with direct-use material to include one of the nuclear power plants.

DOE and the Ukrainian State Committee on Nuclear and Radiation Safety signed an agreement for cooperation in MPC&A in December 1993, and shortly thereafter the two sides agreed to begin cooperative projects at the South Ukraine Nuclear Power Plant and the Kiev Institute of Nuclear Research. Subsequent agreements in 1995 with the Ukrainian Ministry for Environmental Protection and Nuclear Safety (which absorbed the State Committee on Nuclear and Radiation Safety) expanded cooperation to the Kharkiv Institute of Physics and Technology and Sevastopol Institute of Nuclear Energy and Industry.

Early in the discussions a dichotomy became apparent between the U.S. and Ukrainian views on security threats. The United States does not view nuclear power plants as a priority for MPC&A upgrades because their spent fuel, while containing plutonium, poses no immediate proliferation concern.[40] Ukraine, however, considers the security of nuclear plants vital to its national security because the plants supply heat and power that are essential for the country's economy and well-being and could be vulnerable to sabotage. The U.S. MPC&A effort in Ukraine, therefore, has targeted both a nuclear power plant and the three research facilities.

The United States and Ukraine agreed on the Design Basis Threat to be used at each Ukrainian nuclear facility and then proceeded with site surveys, including identification of equipment needs and specifications. Most of the effort is focused on major upgrades of physical protection, including repairing walls, building fences, providing equipment to detect intruders, and training guards. Work has begun on these upgrades, though at the Sevastopol facility a dispute between Ukraine and Russia over control of the Black Sea fleet and possibly the future of the city of Sevastopol and the institute delayed implementation of the U.S.-Ukrainian cooperative effort. This effort is now under way and assistance is being provided to safeguard the material.

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[40] Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium* (Washington, D.C.: National Academy Press, 1994), pp. 150-151.

Belarus

Belarus has one research reactor, which has been deactivated, at the Institute of Nuclear Power Engineering in Sosny, outside Minsk. Fresh fuel containing direct-use material is stored at Sosny. In 1994, the United States joined Sweden and Japan in an international effort organized by the IAEA to upgrade the MPC&A system at the facility. Under that international effort, DOE, together with the Swedish Nuclear Power Inspectorate, assumed the lead responsibility for upgrading facility-level protection of nuclear materials. A bilateral implementing agreement, signed by the United States and Belarus in 1995, formally recognized cooperative efforts already under way. Following site surveys and discussions in 1995, physical protection upgrades were begun at two buildings. The U.S. contribution to that effort, which was completed in September 1996, had included improvements to the central alarm station, installation of tamper-indicating devices, and provision of other equipment and training.[41]

Kazakstan

The Soviet republic of Kazakstan played a central role in nuclear weapons deployment and testing programs. While all nuclear weapons have been transferred to Russia and nuclear testing has ceased, direct-use material remains at several facilities:

- *Aktau*—A BN-350 fast breeder reactor, fueled by LEU and HEU, provides power for both desalinization and residential electricity. Plutonium and other materials accumulated in the reactor's blanket are stored in a pool adjacent to the reactor. This pool also is the storage site for spent fuel. Fresh HEU fuel rods also are present at the facility.
- *Semipalatinsk*—The National Nuclear Center, located about 75 kilometers from the Semipalatinsk test site, conducts research at three reactors using HEU. The center has a total of approximately 200 kilograms of HEU, some of it unirradiated.
- *Alatau* (near Almaty)—The Institute of Atomic Energy, part of the National Nuclear Center, has a VVR-K research reactor, which is not operating. It used 36 percent enriched uranium as fuel. Small stocks of direct-use material are present at the facility.
- *Ulba Metallurgy Plant*—This facility fabricates uranium fuel and produces LEU fuel pellets for reactors. The facility stored HEU until 1994, when the stocks were transferred to the United States under Project Sapphire.[42]

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[41] "DOE Secures Nuclear Material in Belarus and Uzbekistan, Reduces Risk of Nuclear Proliferation," DOE news press release, October 1, 1996.

[42] Under Project Sapphire, approximately 600 kilograms of HEU was transferred to the United States in November 1994.

DOD and the Ministry of Defense of Kazakstan signed an agreement in December 1993 to help contain nuclear and other dangerous materials and technologies in the Former Soviet Union. Effort to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union ment committed the United States to provide assistance valued at $5 million; in June 1995 the level of assistance was increased to $8 million and in June 1996 to $23 million. The two sides selected the Ulba fuel fabrication facility as the first facility for collaborative MPC&A work. The collaboration has since been expanded to the other facilities listed above.

At the facility level, DOE is providing MPC&A instrumentation and equipment and is cooperating on system design, installation, test and evaluation, and associated training. At the national level, the U.S. effort supports the Nuclear Regulatory Commission working with the Atomic Energy Agency of Kazakstan in developing regulations, associated guidance, and mechanisms for assuring regulatory compliance, including licensing and inspection programs. U.S. specialists are also working with colleagues to develop a national system of materials control and accountability, including tracking the movement of material.

While neither the Kazakstani Government nor directors of nuclear facilities consider MPC&A as important a priority as developing future nuclear power sources and ensuring the safety of existing reactors, Kazakstan is clearly prepared to participate energetically in upgrading its MPC&A programs as a step toward gaining the confidence of the West in the reliability of its civilian nuclear power and in its ability to protect its remaining stocks of direct-use material. Kazakstan has accepted the general standards for control and accountability of nuclear material developed under IAEA's international safeguards program and is attempting to ensure that its facilities comply with those guidelines. Ulba is now under IAEA safeguards, and the initial inventory verification by the IAEA at Semipalatinsk has been completed.

MEASURES OF SUCCESS

In approaching the task of evaluating the U.S. cooperative program, the committee considered but did not use highly structured criteria. The efforts and conditions in the FSU are evolving rapidly, making the U.S. program a work in progress; and, in any event, progress to date is not quantifiable. Moreover, the optimal near-term upgrade program against which to judge U.S. efforts cannot be easily framed, given the political and economic uncertainties of the FSU and incomplete knowledge of the status of Russian facilities. In the program's early stages the United States measured progress in quantifiable items, in particular the number of facilities at which cooperative activities were under way. But this approach can lead to an exaggerated sense of success. Recognizing this, DOE has adopted the true standard for assessing progress: reduction in the vulnerability of direct-use material. By this standard, only a small fraction of the MPC&A job is complete.

The measure of overall success of the MPC&A upgrades must be the extent

to which the vulnerability of material is reduced by bringing it under adequate security. Ultimately, control of the high-value materials and technologies in the FSU is the responsibility of the FSU governments themselves. The appropriate measure of the effectiveness of the U.S. program is how well it contributes to achieving that security. This includes emphasizing the importance internationally of MPC&A upgrades, thereby increasing the motivation of the host governments to make such upgrades, and providing the necessary technical and financial support to make the improvements possible in the near term.

As the U.S. role in MPC&A upgrades in the FSU eventually diminishes and comes to an end, the cooperative program should be evaluated on such measures as: Did the United States take advantage of opportunities to increase cooperation? Were technical improvements appropriate to FSU needs? Did the cooperative program strike the right balance between breadth and depth of activity?

In the interim the committee's specific findings are largely qualitative in nature and are intended to provide an overall sense of the progress being made in MPC&A upgrades. The committee's recommendations will help ensure that the answers to the above questions are positive.

GENERAL FINDINGS CONCERNING U.S. COOPERATIVE PROGRAMS

After initial delays of more than two years, primarily because of a lack of interest in Moscow in cooperative arrangements that the United States considered equitable and essential, progress attributable to the joint efforts of U.S. and counterpart specialists in MPC&A greatly accelerated in 1995 and 1996. As already mentioned, DOE estimates that U.S. specialists have gained access to some of the many buildings at approximately 90 percent of the sites where direct-use material is known to be located outside the MOD complex and has initiated cooperative interactions to address many of the most pressing MPC&A issues at those sites. This is a significant political and organizational achievement, considering (a) the complexity of the tasks in transforming the Soviet approach to MPC&A, which had relied primarily on controlling people, to an approach that relies increasingly on technical measures and (b) the history of secrecy throughout the Soviet nuclear complex. But while significant improvements have been made at selected facilities, the task has not been completed at any facility and has only begun at many. The DOE estimates that *tons* of direct-use material are contained in internationally acceptable MPC&A systems and that *tens of tons* are in partially acceptable systems; but adequate MPC&A systems for *hundreds of tons* must still be installed.

It is noteworthy that in Ukraine, Belarus, and Kazakstan cooperative efforts have already achieved discernable technical improvements. Of special interest, DOE announced in 1996 that it had completed MPC&A upgrades at the Institute

of Nuclear Power Engineering in Belarus, the only known facility in Belarus with direct-use material.

The cooperative program with Russia has been stimulated by high-level support from the U.S. and Russian Governments. President Clinton underscored the importance of the cooperative effort in September 1995, with a Presidential Decision Directive accelerating MPC&A cooperation with the successor states and formalizing responsibilities and assignments for the various agencies and departments.[43] Also, the U.S.-Russian Commission on Economic and Technological Cooperation, known as the Gore-Chernomyrdin Commission, has made MPC&A collaboration an important agenda item.[44] President Yeltsin has underscored Russia's own attention to MPC&A with several decrees and executive orders aimed at improving the security of direct-use material. While actual technical progress may fall short of the level of achievement implied by these political statements, the high-level attention to the importance of MPC&A upgrades is nonetheless noteworthy and important.

The efforts to upgrade MPC&A in all four countries have also benefited from support from Japan and Europe. The efforts are gradually becoming more multilateral, with increasingly frequent coordination meetings held among representatives of other interested western countries. The Obninsk training center, which receives support from the European Union, is one example. However, the United States remains by far the largest supporter of activities in the region and is the most focused on direct-use materials.

But while progress has been made, particularly in lessening bureaucratic and other barriers to cooperation and in demonstrating technical approaches, U.S. officials realize much remains to be done—at the technical level, as well as in changing attitudes and instilling a new philosophy that places higher value on individual initiative and responsibility.

The need to continue the momentum of the MPC&A programs and make significant technical improvements as rapidly as possible until such time as MPC&A programs are internalized in the successor states and able to stand on their own is vital to world security. With the constraint of limited U.S. and FSU resources, the program must both encourage completion of work at the selected facilities to bring them up to international standards and move on to the other significant facilities at which upgrades have not yet begun. There is an inherent tension in the goals of the U.S. program between the temptation to initiate activities at as many facilities as possible while the opportunities exist and the need to

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[43] U.S. Presidential Decision Directive 41, September 28, 1995.

[44] For example, in July 1996, at the seventh meeting of the Gore-Chernomyrdin Commission, the two sides signed a Joint Statement on Control, Accounting, and Physical Protection of Nuclear Materials and a Joint Statement on Nuclear Material Protection, Control, and Accounting During Transportation.

bring each facility, particularly those with substantial quantities of material, up to challenges the program will face in the future.

In their meetings and site visits in the United States and abroad, committee members recognized a significant level of commitment to improving the security for direct-use materials among government officials and institute personnel. But committee members realize the problem is immense and that solutions will require significant time, effort, and support at all levels. One assessment underlies the committee's general findings: Given the environment in which the cooperative programs must operate, the committee doubts that much more progress could have been made during the first few years even had significantly more U.S. funding been available. For example, as soon as opportunities arose, the resources rose dramatically from tens of millions to 100 million dollars per year.

Having overcome political, cultural, and organizational hurdles, the challenge now is to extend the program's organizational and political achievements to significant technical improvements—a process that is at its early stages. As the program moves into the next stage of rapid implementation, certain overarching principles should guide the cooperative efforts.

- For the near term it is essential that the United States *sustain* its involvement until counterpart institutions are in a position to assume the full burden of upgrading and maintaining MPC&A programs over the long term.
- Emphasis should be on development and improvement of the capabilities of both officials and specialists in the four successor countries, reliance on local expertise and whenever possible local equipment, and establishment of viable funding sources—in short, actions to *indigenize* the activities.
- The U.S. and cooperating governments and institutions should *simplify* the problem, by reducing and consolidating direct-use material of concern.
- The program should include more concerted efforts to *minimize the opportunities to bypass* the MPC&A systems that are installed.
- The participating specialists should *enhance* their approaches in several program areas to increase the effectiveness of their joint efforts.

RECOMMENDATIONS TO THE U.S. GOVERNMENT CONCERNING FUTURE COOPERATION IN MPC&A

1. Sustain the Program

Finding: By mid-1995, projects at more than two dozen facilities were under way throughout the FSU, and by mid-1996 cooperation under both the lab-to-lab and government-to-government programs had expanded to other significant facilities. (The 44 sites at which DOE was working on MPC&A upgrades as of the end of fiscal year 1996 are listed in Table 4.1.)

TABLE 4.1 Sites of MPC&A Cooperation (as of July 1996)

MINATOM Civilian Complex

1. Scientific Research Institute of Atomic Reactors, Dimitrovgrad
2. Machine Building Plant, Electrostal
3. Institute of Physics and Power Engineering, Obninsk
4. Luch Scientific Production Association, Podolsk
5. Chemical Concentrates Plant, Novosibirsk
6. Beloyarsk Nuclear Power Plant, Zarechny
7. Branch of Scientific Research and Design Institute of Power Technology, Zarechny
8. Scientific Research and Design Institute of Power Technology, Moscow
9. Khlopin Radium Institute, St. Petersburg
10. Central Design Bureau of Machine Building, St. Petersburg
11. Institute of Theoretical and Experimental Physics, Moscow

MINATOM Defense Complex

12. All-Russian Scientific Research Institute of Experimental Physics, Arzamas-16 (Sarov)
13. Mining and Chemical Combine, Krasnoyarsk-26 (Zheleznogorsk)
14. Electrochemical Plant, Krasnoyarsk-45 (Zelenogorsk)
15. Mayak Production Association, Chelyabinsk-65 (Ozersk)
16. All-Russian Scientific Research Institute of Technical Physics, Chelyabinsk-70 (Snezhinsk)
17. Urals Electrochemical Integrated Plant, Sverdlovsk-44 (Novouralsk)
18. Siberian Chemical Combine, Tomsk-7 (Seversk)
19. Eleron (Special Scientific and Production State Enterprise), Moscow
20. All-Russian Scientific Research Institute of Automatics, Moscow
21. Bochvar All-Russian Scientific Research Institute of Inorganic Materials, Moscow

Independent Civilian Sector

22. Russian Scientific Research Center, Kurchatov Institute of Atomic Energy, Moscow
23. Karpov Institute of Physical Chemistry, Obninsk
24. Scientific Research Institute of Nuclear Physics, Tomsk
25. Nikel Plant, Norilsk
26. Institute of Nuclear Physics, St. Petersburg
27. Joint Institute of Nuclear Research, Dubna
28. Moscow Engineering Physics Institute

Naval Nuclear Fuel Sector

29. Northern Fleet
30. Pacific Fleet
31. Icebreaker Fleet (Murmansk Shipping Company)

Non-Russian NIS Sector

32. Institute of Nuclear Power Engineering, Sosny, Belarus
33. Institute of Physics, Tbilisi, Georgia
34. Mangyshlak Power Generation Company, Aktau, Kazakstan
35. Institute of Atomic Energy, Alatau, Kazakstan
36. National Nuclear Center, Semipalatinsk, Kazakstan
37. Ulba Metallurgy Plant, Ust-Kamenogorsk, Kazakstan
38. Institute of Nuclear Physics, Salaspils, Latvia
39. Nuclear Power Plant, Ignalina, Lithuania
40. Kharkiv Institute for Physics and Technology, Ukraine
41. Kiev Institute of Nuclear Research, Ukraine
42. Sevastopol Institute of Nuclear Energy and Industry, Ukraine
43. South Ukraine Nuclear Power Plant, Konstaninovsk, Ukraine
44. Institute of Nuclear Physics, Tashkent, Uzbekistan

Source: U.S. Department of Energy.

TABLE 4.2 Funds for MPC&A, Budgeted (Obligated)

Defense Special Weapons Agency

Fiscal Year	Russia	Belarus	Kazakstan	Ukraine
1992	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1993	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1994	0.8 (0.0)	0.0 (0.0)	3.3 (0.0)	2.4 (0.0)
1995	38.2 (0.8)	2.6 (2.6)	2.7 (3.3)	17.0 (2.4)
1996	0.0 (38.2)	0.3 (0.3)	15.0 (2.7)	0.0 (10.0)
1997	0.0	0.0	0.0	0.0
Total	39.0 (39.0)	2.9 (2.9)	21.0 (6.0)	19.4 (12.4)

Source: Defense Special Weapons Agency.

Department of Energy

Fiscal Year	Russia	Belarus	Kazakstan	Ukraine
1992	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1993	2.5 (2.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1994	3.0 (3.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
1995	9.6 (9.6)	0.2 (0.2)	0.3 (0.3)	0.3 (0.3)
1996	76.1 (61.1)	0.1 (0.1)	5.9 (5.9)	0.5 (0.5)
1997	88.9	0.1	4.5	0.5
Total	180.1 (76.2)	0.4 (0.3)	10.7 (6.2)	1.3 (0.8)

Source: U.S. Department of Energy.

To date, U.S. support for the program has grown steadily. Beginning in 1996, DOE took over funding responsibilities from DOD for management and implementation of the MPC&A program, including the government-to-government program, with considerable simplification of procedures. Funding for the overall U.S. effort has expanded in recent years from several million in fiscal year 1994 to over $100 million in fiscal year 1997. (Table 4.2 provides a summary of funding for the U.S. MPC&A effort.) This increase reflects the fact that the cooperative program is moving beyond the organizational stage to that of implementing technical upgrades in the FSU.

The continued flow of U.S. funds in the near term is essential because of the limited ability of the four governments to finance MPC&A upgrades.[45] The next few years will be a critical period to take advantage of the new opportunities to cooperate in upgrading systems to an acceptable level. U.S. specialists are in a

[45] The committee notes that multiyear funding for the bilateral programs would increase the stability and continuity of the cooperative efforts but acknowledges that U.S. congressional procedures make multiyear funding unlikely.

unique position to help ensure that such upgrades are given high priority and

Efforts to Help Contain Nuclear and Other Dangerous

Recommendation: Continue to fund MPC&A efforts in the FSU at least at the level of fiscal year 1996 for several more years and be prepared to increase funding should particularly important high-impact opportunities arise. Continued funding will allow the U.S. and FSU governments to carry on cooperation at the technical level at important facilities. The present level of funding is satisfactory for the tasks recommended in this report, which can be achieved with a U.S. work force of about the same size as is currently engaged in the joint programs. In principle, additional funds could be used to increase the rate of implementation, but whether Russia and the other successor states will be able to absorb and use effectively the recent rapid increase in U.S. funding remains to be demonstrated. Another limitation on the size of the program in Russia, of course, is the readiness of MINATOM to expand efforts. If previously closed facilities unexpectedly become open for cooperative efforts, DOE should request additional funds.

2. Indigenize MPC&A Capabilities

Finding: Once U.S. funding ends, the cooperating governments must be committed and able to assume full responsibility for funding and maintaining upgraded MPC&A systems. The challenge is great, as economic shortfalls even for basic program support limit the domestic funds available for MPC&A. Many nuclear facilities are in poor or deteriorating condition, and the economic situation in the FSU makes any dramatic improvement unlikely in the near term. Shortages of funding for facility maintenance and basic program support make it difficult to give high priority to internal funds for MPC&A. In some cases, funding is not available even for installation and maintenance of equipment provided by others. Ministries, institutes, and individuals will need access to income streams that will permit them to continue their efforts in the long term.

DOE's approach to MPC&A projects has appropriately stressed their collaborative nature and the mutual benefits from increased security. Although keeping direct-use material out of countries of proliferation concern and terrorist groups is vital to U.S. national security, MPC&A is clearly a national responsibility; and U.S. assistance should develop and strengthen indigenous MPC&A capabilities. Officials and specialists in the four successor countries will understandably undertake "cooperative activities" on sensitive issues such as MPC&A much more readily than they will accept "assistance." It becomes even more important to define the program in terms of cooperative activities, looking to the day when U.S. funding scales down and the FSU governments and facility managers are expected to assume responsibility for MPC&A.

Recommendation: Continue to emphasize the importance of MPC&A as a nonproliferation measure at the highest political levels in the FSU. Many officials in the region do not attach great importance to proliferation as an international security threat. Steps in MPC&A may sometimes be taken more to satisfy the U.S. and other western governments than out of serious concern over proliferation. Senior U.S. officials should continue to emphasize in interactions with their FSU counterparts the commonality of U.S. and FSU interests in the nonproliferation sphere.

In addition, to help ensure that the United States is not alone in pressing the countries on the importance of nonproliferation, the United States must maintain diplomatic priority and appropriate support for the IAEA and other international approaches, particularly initiatives of the G-7 governments.

Recommendation: 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 to stimulate long-term commitments. The U.S. program does not require institutes or governments to provide any assurance that they will sustain MPC&A upgrades after U.S. funding ends. In some facilities MPC&A equipment and technology might be used for other purposes after the cooperative efforts are completed. At the Kiev Institute for Nuclear Research, for example, the main interest of the staff is to restart the reactor, which they hope to do in 1997. But the dire financial situation of the institute suggests that computers and some other equipment provided by the United States for MPC&A could be diverted to support the reactor research program. At the Institute of Nuclear Power Engineering in Belarus, physical protection upgrades have been completed, but there is no assurance that the government or institute will be able to maintain the newly installed system. Consequently, efforts should be made to assure that both ministries and facilities have the incentives to implement a sustained MPC&A program.

Recommendation: Involve institute personnel to the fullest extent possible in determining how to use available funds for upgrades. The U.S. program has sought to include working-level personnel in the FSU institutes in decisions on equipment needs, specifications, and installation. However, the strict decision-making hierarchy and centralization of authority in most institutes can make this difficult. Developing ways to maximize the involvement of working-level personnel in key decisions on MPC&A upgrades should encourage them to assume responsibility for the upgrades.

Recommendation: Give greater emphasis to near-term training of local specialists. Developing indigenous capabilities in all aspects of MPC&A sys-

tems is a key to having the FSU governments assume full responsibility for their [illegible] The U.S. program should continue to support the establishment of an MPC&A training facility at the Methodological Training Center in Obninsk, which will be managed by Russian specialists and provide an important means to "train the trainers" for future maintenance of the upgraded MPC&A systems. The European Union, through Euratom, is also contributing to the center, where training courses began in October 1995 and are gradually expanding. Effective courses were held in the spring and summer of 1996 on the overall design of MPC&A systems and on specific problems of software engineering for the design of control and accountability systems. As part of the effort to create a "safeguards culture" as well as to increase technical skills, coursework included studies of the international problems of proliferation and international cooperation to prevent it. The United States should also incorporate appropriate training programs at an early stage of bilateral activities at each facility where joint MPC&A programs are under way so as to ensure rapid transition from assistance to cooperation at these facilities.

Recommendation: 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. DOE and other U.S. government agencies have an array of cooperative programs under way in the FSU in addition to the work on MPC&A. DOE's Initiatives for Proliferation Prevention (formerly the Industrial Partnering Program), for example, uses U.S. laboratories as intermediaries to facilitate U.S. investments at FSU institutes. This and other cooperative programs involve work with the same facilities where DOE is helping to upgrade MPC&A. It should be a relatively easy task to give priority for such cooperation to institutes whose MPC&A performance is particularly strong.

Recommendation: 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 HEU. Developing sustainable domestic funding sources in the FSU for any activity presents a significant challenge in the current economic climate of the region. The most feasible approach to ensure funding for MPC&A in the near term may be to use revenues that are becoming available to Russia or the other FSU countries from closely related activities, particularly other U.S. or western programs to reduce the risk posed by direct-use materials. The proceeds from the U.S. purchase of 500 tons of HEU from dismantled Russian nuclear weapons is an example of a source that might be tapped.

Recommendation: Rely increasingly on domestically produced and locally available equipment for physical protection, detection, analysis, and

related MPC&A tasks. The purchase and use of FSU equipment and technology Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union and reduce acquisition, transportation, and maintenance costs. One example of successful use of Russian technology is the reliance on equipment produced by Eleron, a MINATOM enterprise that specializes in R&D and production of physical protection equipment. Eleron provides important specialized services, operation and maintenance, and training for security personnel.

This practice should be expanded to the extent that appropriate equipment is available. Officials in Ukraine expressed concern to the committee that they have not been consulted on equipment purchases and that equipment comparable to that purchased from U.S. firms could be bought at a lower cost in Ukraine or Europe (saving transportation costs). Because the Ukrainians will have to operate as well as maintain the equipment after the U.S. program ends, using locally available equipment whenever possible is clearly a wise choice.

3. Simplify the Problem

Finding: The amount of material and its dispersion in many buildings at many facilities increase the cost and complexity of MPC&A upgrades, as well as the risk of diversion. There are a number of cases in which upgrades are under way for selected buildings or for caches of material, while comparably important buildings or stocks of material at the same facility are not being addressed. The challenge of controlling small amounts of direct-use material located in hundreds of buildings, including many in a poor state of repair, seems overwhelming. If the amount of material and/or the number of storage areas could be substantially reduced, the time and costs involved in installing and maintaining MPC&A systems also could be significantly decreased.

Some initiatives in this direction will require strong efforts. The possession of direct-use material is viewed as essential to participation in some of the most cherished aspects of the FSU nuclear program. Thus, if the material is removed, the raison d'etre of the facility may suffer as a consequence. Holding direct-use material may also confer status on a facility or a laboratory director that would not otherwise be available. And if the material is removed, the flow of U.S. funds for MPC&A also could cease.

Nonetheless, the security benefits of consolidation are significant enough that efforts to overcome these obstacles are a priority, particularly at facilities where there may be redundant stocks of especially proliferation-sensitive material. One possible approach would be to allow an institute to maintain ownership of material that is stored elsewhere. In any case, the proliferation benefits of consolidation will not be achieved if consolidation will deprive the institutes of funds they would otherwise expect to receive. Creative use of some of the incentives recommended in this chapter may be necessary to elicit support for consolidation.

Related to the specific consolidation measures recommended below but out-

side the scope of this study is the issue of continued production of plutonium in Russia. The United States is trying to persuade Russia to shut down its remaining production reactors at the reactors in Krasnoyarsk and Tomsk. Also, closing the nuclear fuel rod reprocessing plant at the Mayak complex, where almost 30 tons of separated reactor-grade plutonium is already stored and more is being generated, has been strongly advocated by some U.S. specialists.

Future use of the small stocks of direct-use material outside Russia is uncertain at best. Retaining these stocks even in a limited number of locations requires significant MPC&A expenditures and continued vigilance against the possibility of theft.

Recommendation: In Russia, encourage consolidation of direct-use material in fewer buildings, at fewer facilities, and at fewer sites. Where economically feasible, consolidating the material could significantly simplify the task facing the cooperative program at a number of sites. Russian officials and facility managers recognize the problems posed by widespread stocks of direct-use material, and DOE has encouraged recent consolidations at a number of facilities. At Obninsk, for example, plans are in place to consolidate the current 30 material balance areas, all of which need improved MPC&A.[46] The original plan was to consolidate the material to two major "nuclear islands," one for the critical assemblies and one for the institute's other activities. That approach has proved more costly than was anticipated. Obninsk officials now estimate that the task will take three to four years to complete and that they may have to settle for some smaller islands because of the diversified nature of the research activities. DOE states that it will encourage consolidation when it can but generally regards this approach as taking advantage of targets of opportunity rather than as a priority at the present time.

Recommendation: Take steps to encourage the removal of all HEU at research facilities outside Russia, including the purchase of HEU when appropriate. One of the largest amounts of non-Russian direct-use material is the HEU at the Kharkiv Institute in Ukraine, where approximately 70 kilograms is stored. Purchase of this material should be considered. Some of the proceeds of the sale might be earmarked for MPC&A upgrades at the facility. The price would be a matter of negotiation, but there are precedents in both the ongoing U.S. purchase of 500 tons of HEU and the earlier purchase of almost 600 kilo-

[46] Material balance areas are separate parts of a facility in whose boundaries reliable inventories of nuclear materials can be established and material flows in or out can be monitored (Office of Technology Assessment, *Nuclear Safeguards and the International Atomic Energy Agency*, U.S. GPO, Washington, D.C., 1995, p. 114).

grams of HEU from Kazakstan in Project Sapphire.[47] Similar purchases should be considered for HEU and PU facilities in Russia and the Newly Independent States as other recommendations.

Recommendation: For research reactors outside Russia where important and adequately financed research programs are planned in the foreseeable future, support conversion of the reactors so that they can use LEU instead of HEU. U.S. policy has long favored conversion of research reactors using HEU to reactors using LEU as a nonproliferation measure. The United States has previously provided direct support to a number of countries for such conversions. Conversion assistance would include replacement of existing stocks of HEU fuel with LEU fuel and assistance to modify the reactors. The United States should not become involved in indefinitely subsidizing the operation of these reactors, but for several facilities conversion assistance offers the best near-term prospect for returning to active research while also reducing proliferation problems.

4. Minimize the Opportunities to Bypass MPC&A Systems

Finding: If a national MPC&A program is to be effective, all relevant organizations and all sources of direct-use material must be addressed. Large stocks of direct-use material are located at some Russian facilities that have not yet become active participants in the bilateral program. Also, there is uncertainty among both Russian and American specialists as to the precise amounts of direct-use material present at many facilities, given the history of maintaining stocks of material "off the books" and the weaknesses in past inventories. As more stringent MPC&A systems are being installed at the facility, temptations to hold material outside these systems may arise. During a period of political and economic turmoil and expanded criminal activities, efforts to remove material from the MPC&A systems as a first step to subsequent diversions may emerge. At the same time, an important oversight agency in Russia, the State Nuclear Regulatory Committee (Gosatomnadzor or GAN), suffers from a shortage of well-trained inspectors, qualified staff, and necessary analytical and related equipment. Also, GAN's administrative authority in areas related to military activities is very uncertain.

Recommendation: Ensure that all stocks of direct-use material are encompassed in the program, including icebreaker nuclear fuel, supplies at naval facilities, and off-specification and scrap material. Some institutions with responsibility for direct-use material have been more reluctant than others to

[47] *Avoiding Nuclear Anarchy*, pp. 102-106.

open their facilities to U.S. specialists. For example, the U.S. collaborative program was not able to install fuel-use monitors on Russian naval reactors until 1996. In this case, both the Russian and the U.S. navies were concerned about the precedents that openness might create. In addition, scrap and off-specification materials from weapons production, some of which is direct-use, are not yet included in cooperative MPC&A programs.

Recommendation: Encourage rapid development of a comprehensive national material control and accounting system in Russia and the prompt incorporation of all existing direct-use material into that system. All relevant agencies in Russia, including GAN, have agreed on the concept of such a system. The initial activity would be managed by Atominform, a MINATOM institute, and individual facilities are undertaking their own inventories, using a standard approach. The project is expected to proceed slowly, however. DOE is providing financial support and equipment but should elevate the priority it gives to a national system.

Recommendation: In Russia, increase support of GAN as an important independent agency by assisting it in developing MPC&A methodologies, training inspectors, obtaining staff support from research institutions, and procuring necessary equipment for MPC&A inspections. The involvement of a competent independent regulatory agency will significantly bolster long-term MPC&A program development and maintenance and increase confidence that diversions would be detected in a timely manner. Such an organization will help deter attempts to elude MPC&A systems at facilities. At the moment, GAN has the potential to become such an agency in Russia but needs clarification of its administrative authority in military-related areas, enhanced technical capability, and more effective relationships with other government agencies.

Recommendation: Encourage a system of incentives, possibly including monetary rewards, that will stimulate participants in MPC&A programs to report promptly to the central authorities any irregularities in the implementation of MPC&A systems. An important part of developing an MPC&A culture in the FSU is conveying to workers and managers the importance of immediately reporting any indication of theft or diversion. Financial rewards for whistle blowers might be particularly effective in view of the economic problems there.

Recommendation: Emphasize the importance of developing a culture among MPC&A specialists that does not tolerate shortcuts or exceptions in implementing MPC&A systems. Under the Soviet system, workers were generally expected to subjugate their views and actions to their superiors, even if that meant breaking rules. To be effective, MPC&A upgrades must take place in a

management atmosphere that stresses individual responsibility and places a high value on high-quality performance. The U.S. cooperative program should continue to stress such non-technical aspects of MPC&A.

5. Enhance the Program

Finding: A number of enhancements would increase the effectiveness of U.S. efforts. The threats of theft and diversion in the FSU differ significantly from threats in the United States. In addition to the general economic and crime situations, which may create specific threats, there are differences among the facilities that affect their susceptibility to loss of material. Many buildings where direct-use material is stored are in poor repair, long perimeters with inadequate protection characterize some sites where material is located, and old accounting systems of dubious reliability are used at some facilities. Some local specialists are not prepared to use sophisticated technologies effectively. Modest immediate enhancements at a large number of facilities may be more important than major investments at a limited number of storage locations.

A second area of concern is the vulnerability of direct-use material during transport, which to date has not been a priority for the bilateral programs. Relatively large quantities of material move on a regular basis among the sites that comprise different parts of the MINATOM complex, and much of the hauling is done with ordinary trucks or vans rather than special armored vehicles. At Electrostal, for example, officials acknowledge that truck transport is a weak link of the MPC&A system. In particular, the accounting process to track material as it moves from one storage site or one facility to another may not be sufficiently developed and implemented.

In addition, the continued isolation of some facilities where MPC&A upgrades are needed limits opportunities for specialists at one facility to learn from the experiences of their colleagues at other facilities.

Finally, several agencies are usually involved in providing security for direct-use material, including responding to incidents and alarms. The Ministry of Interior and the Federal Intelligence Service do not appear to be seriously involved in designing MPC&A upgrades, which is the responsibility of specialists of MINATOM or other concerned research organizations.

Recommendation: Emphasize MPC&A approaches that respond to threat scenarios that are appropriate for the FSU, recognizing that they may differ from the threat scenarios used in the United States. One of the sensitive issues in cooperating with Russia and other states in the design of MPC&A upgrades is the choice of threat scenarios that are the basis for the physical protection systems. The current U.S. approach is based largely on U.S. threat scenarios. A number of officials told the committee that the threat of sabotage is a matter of more serious concern in the FSU than the United States has recog-

nized. The U.S. approach is intended to improve protection against theft or diversion. Efforts to help contain nuclear and other dangerous materials and technologies in the former Soviet Union U.S.-style MPC&A system would certainly impede a would-be saboteur from gaining access to a facility, but may not protect vulnerable areas inside the facility that are sabotage targets. This difference in focus requires prompt attention.

Recommendation: Recognize that in the near term it may be necessary to install systems that fall short of internationally accepted standards in anticipation of subsequent refinements. In this regard, use appropriate MPC&A measures, whether they involve high-tech or low-tech approaches. The physical protection systems being recommended by U.S. specialists reflect how a U.S. facility would respond to such problems. Comprehensive sophisticated systems may not be the most cost-effective use of funds or the fastest means of establishing protection, however. For example, replacing wax seals with modern tamper-indicating devices could quickly provide an enhanced level of protection at many storage sites. Replacing flimsy warehouse doors with sturdy doors and strong padlocks can be done quickly. Other low-tech investments in consolidation, vaults, and fencing might be appropriate first steps at many facilities. Also, hand-held radiation detectors could provide an interim step in providing some protection before the installation of portal monitoring equipment is completed at all facilities.

Recommendation: In Russia, give greater attention to MPC&A of direct-use material during transport within and between facilities. At an early stage, the DOD-MOD program addressed the vulnerability of railroad cars used to transport nuclear warheads, and this remains a priority in the cooperative effort on weapons control and accountability. But the DOE MPC&A program began to address transportation problems only in June 1996, when an agreement between MINATOM and DOE provided the framework for a new cooperative effort. Yet, as previously noted, transportation vulnerabilities were readily acknowledged by Russian officials to committee members.

Recommendation: Promote greater communication and cooperation among ministries and facilities involved in MPC&A in each of the countries where bilateral programs are being implemented. Exchange of information among relevant officials at the facilities concerning approaches and successes will improve efficiency and the rate of progress of the overall MPC&A effort. The benefits of increased communication were evident at the week-long Conference on Non-Proliferation and Safeguards of Nuclear Material held at the Kurchatov Institute in May 1996 and cosponsored by DOE, where officials from numerous Russian institutes and U.S. laboratories discussed MPC&A strategies and results. DOE is planning to co-sponsor with MINATOM a major interna-

tional conference in 1997 on MPC&A that will bring together specialists from Russia and the United States.

Recommendation: In Russia, encourage more active involvement of the Ministry of Interior in the planning, testing, and implementation of physical security systems. An important component of the physical protection system is the "response team"—the guards or police trained to respond if an incident occurs. Public and private facilities in the United States place great emphasis on the readiness of these teams, include them in the development of vulnerability assessments, and conduct regular exercises to test the effectiveness of the response.

In Russia, the Ministry of Interior both supplies the guards for the perimeter of the sites and is responsible for responses. The division of labor is similar in the other three countries of concern. But the involvement of the Ministries of Interior in the new MPC&A systems being installed with U.S. cooperation is uncertain. Russian officials expressed concern about designing physical protection systems without the full participation of the agency charged with a major role in implementing them. Similarly, officials at the Kharkiv Institute of Physics and Technology in Ukraine expressed concern about whether troops stationed across the city would be able to respond in time to be of real assistance.

To date, DOE has believed that the sensitivity of vulnerability assessments and threat scenarios would make the Ministries of Interior reluctant to cooperate openly with the U.S. agencies, and therefore DOE has not sought regular involvement from the ministries. In a few cases the cooperative programs have taken advantage of opportunities at individual facilities where cooperation could be established, but this piecemeal approach is not sufficient. In Russia, the success of the cooperation with MINATOM and other independent institutes suggests that, provided financial incentives are available, senior officers from the Ministry of Interior might be willing to participate more actively in efforts to improve physical protection.

AREAS FOR ADDITIONAL STUDY

Consideration of MPC&A activities touches on many related areas of national security importance. Some of the areas beyond the scope of this report that deserve further study include the following:

- *Physical protection, control, and accountability of nuclear weapons in Russia*. The bilateral program of cooperation between DOD and MOD is now beginning to focus more sharply on protection of nuclear weapons throughout the Russian military complex. Some of the approaches used in the MPC&A bilateral program may be relevant to these new efforts.
- *Nuclear smuggling*. The interests and capabilities of organized crime to penetrate the nuclear establishments of the countries of the region need additional

attention. While the bilateral MPC&A programs should address some aspects of these issues, the U.S. intelligence community could contribute more to a full assessment to the possible extent and probably could provide additional perspectives on the problem.

- *Radiological weapons*. The feasibility of terrorists acquiring radioactive material (e.g., spent fuel rods) and disseminating it through high-explosive weaponry or other means is of increasing concern. More serious assessment of this type of threat might suggest refinements in the overall strategy for MPC&A programs.
- *Sabotage at nuclear facilities*. Deterring saboteurs from penetrating nuclear reactor sites or other sites containing dangerous materials and defining means to counter such penetrations are rapidly becoming important dimensions of international crime prevention. The MPC&A programs should provide useful insights on how to approach this problem.
- *Reducing the inventory of direct-use materials*. The U.S. and Russian governments are implementing a program for American purchases of HEU and supporting studies of alternatives for permanent disposition of plutonium. These efforts should be vigorously pursued, since the smaller the inventory the less difficult the MPC&A problem. None of the likely disposition options could begin implementation in less than 10 years, however, so protecting the material remains an urgent security problem.

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Systems for Controlling Exports of Militarily Sensitive Items

SCOPE OF EXPORT CONTROL REQUIREMENTS

Large Repositories of Weapons-Related Items

The Soviet military-industrial complex produced an enormous variety and quantity of weapons and weapons-related items. Thus, the export potential of the successor states of the former Soviet Union (FSU)—particularly Russia, Ukraine, Belarus, and Kazakstan—is of great significance from the viewpoint of U.S. national security interests.[1]

For several decades the Soviet military-industrial complex was the major supplier of weapons and supporting systems for use in the Soviet Union, the other countries of the Warsaw Pact, and many countries in other regions. The enterprises provided a wide range of technologies incorporated into rocket systems, jet aircraft, tanks, automatic rifles, electronic systems, lightweight alloys, and hundreds of other types of armaments and related commodities. With the demise of the USSR, however, many manufacturing enterprises have greatly reduced their weapons-related production activities because of the absence of significant orders by the successor governments. Of course, some manufacturing lines have

[1] According to Jacques Sapir, 73 percent of the Soviet Union's defense industry was in Russia, 15 percent in Ukraine, 5 percent in Belarus, and 3 percent in Kazakstan (Jacques Sapir, "Defense Conversion and Restructuring in the Russian High-Technology Sector: Is There an Alternative to Uncontrolled Exports?" in Judith Sedaitis, ed., *Commercializing High Technology: East and West*, Center for International Security and Arms Control, Stanford University, Calif., January 1996, p. 111).

continued to produce weapons and dual-use items for the defense ministries, primarily for export, and many of these enterprises have been authorized to sell such commodities abroad, with mixed success.[2]

At the same time, large stocks of weapons and other military equipment left over from Soviet times, as well as recently produced items, are now located in marshalling yards, warehouses, and other storage areas. The future disposition of many of these goods is uncertain. Dual-use items such as electronic control devices, specialty materials, advanced manufacturing equipment, and other commodities for supporting military activities are being stored in anticipation of possible future sales to recover some of their value.[3]

Eventual disposition of "surplus" items by governments or by enterprises through transfers to local organizations with uncertain security systems or to other countries that could use them in a provocative manner raises apprehensions in the West. At the same time, many of the goods have considerable value, both for military end users and for commercial organizations with capabilities to adapt dual-use equipment to civilian needs.

The implementation of arms control agreements and related activities are adding to stockpiles large quantities of particularly sensitive material and equipment, as well as large inventories of conventional weapons. The sensitive items include direct-use nuclear material, chemical agents, and components for missiles and nuclear weapons. However, these items are usually located in separate areas that are distant from stockpiles of less sensitive items.

Of special concern is the limited attention of the governments of the successor states to controlling technical data.[4] Such data might describe in detail, for example, the technologies embodied in weapons of mass destruction and sophisticated conventional weapons systems. Such data are contained both in archives and in the expertise of the scientists and engineers who have been involved in developing, manufacturing, and maintaining the weapons and supporting systems.

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[2] See "Rosvooruzheniye Expects 1996 Arms Sales to Top $7 Billion" and "Russia Competes Again for Arms Trade," both in *Moscow Times*, March 28-April 3, 1996, for information on trends in Russian arms sales.

[3] Discussions during the committee's visit to Russia in May 1996. In fall 1993, Gennadi Petrovich Voronin, deputy to the chairman of the Russian Federation Committee on Defense Industry, stated that Russia had a weapons stockpile ready for export worth $20 billion (G. Voronin, "How Russia's Defense Industry Responds to Military-Technical Policy," *Comparative Strategy*, vol. 13, no. 2, April 1994, p. 84). For additional information on this topic, see the interview with Nikolai Shumkov, head of the Main Department to Guarantee Supervision and Utilization of Armaments and Military Hardware of the State Committee for the Defense Industry, in *Military Parade*, Jan./Feb. 1995, pp. 94-96.

[4] Discussions during the May 1996 committee visit indicated that, while materials and commodities were high export promotion and control concerns, technical data were treated as a much lower priority.

In some cases, controlling the international flow of sensitive technical information is more important than controlling the commodities themselves. Some countries of proliferation concern may be capable of building their own weapons systems if they have access to the technologies set forth in technical documentation or to guidance provided by experienced specialists. Also, they may be interested in adapting existing designs of weapons systems and supporting equipment to their special needs, drawing on foreign experiences embodied in technical data.

Growing Interests in Producing Dual-Use Items

As military orders declined, almost all defense enterprises in the four successor countries began searching for new products they could manufacture for civilian markets.[5] Much of the civilian production of the former Soviet military plants has long been directed to simple consumer goods that do not require a high level of technology (e.g., food products, trucks, refrigerators, television sets).[6] However, many enterprises and research and development institutes, with their sights on both international and domestic civilian markets, are now seeking to use more advanced capabilities to produce high-technology items. As they attempt to convert sophisticated military technologies to civilian applications, they inevitably become involved with many items that are included on international dual-use export control lists.[7] Materials and equipment associated with the production of biological and chemical warfare agents present particularly difficult control problems because some of the same technologies have applications in pharmaceutical, agricultural, and other civilian areas.[8]

As in the case of commodities produced solely for weapons purposes, much of the technology underlying dual-use goods is reflected in design documents and operating manuals. Since access to such documentation could, in many cases, save considerable time and resources of commercial competitors attempting to

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[5] See Kevin O'Prey, *A Farewell to Arms? Russia's Struggle with Defense Conversion* (New York: Twentieth Century Fund Press, 1995), pp. 44-47, and Tarja Cronberg, "Civil Reconstruction of Military Technology: The U.S. and Russia," *Journal of Peace Research*, vol. 31, no. 2, May 1994, pp. 213-217.

[6] Before the process of large-scale conversion was begun in the late 1980s, 40 percent of production by volume in military plants was for civilian goods. By 1993 it was up to 75 percent (Albert Trifonov, "Russian Defense Industry Policy," *Comparative Strategy*, vol. 13, no. 1, January 1994, p. 87).

[7] For further discussion of these problems, see Glenn E. Schweitzer, *Moscow DMZ: The Story of the International Effort to Convert Russian Weapons Science to Peaceful Purposes* (Armonk, N.Y.: M. E. Sharpe, 1996) pp. 121-138.

[8] U.S. Congress, Office of Technology Assessment, *Proliferation of Weapons of Mass Destruction: Assessing the Risks* (Washington, D.C.: U.S. Government Printing Office, 1993), p. 6.

produce and market comparable items, the technical specifications and related efforts to help contain nuclear and other dangerous materials and technologies in the Former Soviet Union accordingly. However, only in Russia are the ground rules for such protection reasonably well developed, but even there effective implementation and enforcement seem to be problematic. In any event, a party seeking technical data for use in designing new types of weapons systems probably would not be deterred by violations of patent and copyright laws.

Challenge for Export Control Authorities

Export control authorities are thus faced with the reality that many technologies in the aerospace, nuclear, chemical, and biological fields are inherently dual-use, requiring only modest adaptations for different end uses. Hundreds of facilities in the four countries—particularly Russian enterprises and institutes from the former Soviet military-industrial complex—are attempting to market items embodying sensitive technologies.[9]

Most of the manufacturing enterprises and research institutes involved in design and production of weapons and dual-use items are owned or controlled directly by governments, with only a limited number of smaller private firms and individual entrepreneurs gradually obtaining the capability to manufacture some dual-use items.[10] Despite controls that the governments can exert over state enterprises, few firms appear to give sufficient attention to export control. The principal concern of almost all firms is increasing their sources of income—a completely understandable response at a time when they are having difficulties meeting payrolls and paying utility bills. Although export control procedures exist, some exporters may know little about regulatory policies and practices. Others may assume that, if they are to receive substantial cash payments for their goods, they will be able to work out any problems with the government ministries.[11]

The ministries themselves are under considerable pressure to assist the enterprises and institutes in obtaining foreign contracts and thereby maintain their industrial and scientific capabilities. Such an orientation may mean open advo-

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[9] Discussions during the committee's visit to Russia in May 1996. For a listing of many of these enterprises, see Bureau of Export Administration, *Russian Defense Business Directory* (Washington, D.C.: U.S. Department of Commerce, 1995), and *Investment Opportunities in Ukrainian Defense*, (Washington, D.C.: U.S. Department of Commerce, 1996).

[10] Even for weapons-related firms that are partly or entirely in private hands, the government has a number of ways to influence the enterprise management. See Clifford Gaddy, "Market Reform and Defense Industry in Russia: Who's Adjusting to Whom?" *The Brookings Review*, vol. 14. no. 3, Summer 1996, p. 32.

[11] These attitudes were reflected in discussions by the committee in Russia with both government officials and enterprise managers, although specific examples were not cited and there was no indication of how widespread these views are.

cacy for expanded sales or simply staying out of the way of the enterprise directors. For example, Russia's Ministry of Defense and Technologies and the Ministry for Atomic Energy (MINATOM) are vocal advocates for exports of high-technology products. While these ministries are active participants in the evolving export control systems, at the same time they push hard to enable the enterprises for which they have responsibility to follow up every lead for possible sales that technically comply with international requirements.[12]

Important overseas targets for sales of both military and dual-use items are the long-standing consumers of Soviet products, particularly governments and organizations in Asia and the Middle East. In 1995, 80 percent of Russia's military sales were to China and India.[13] For dual-use technologies, additional countries in Asia, such as South Korea, and nations throughout Europe also are considered as high-priority marketing arenas by enterprise directors. Both Russia and Ukraine are having some success in reaching western markets with aerospace technologies,[14] and a number of Russian enterprises are developing western markets for dual-use items that are on control lists. Meanwhile, research institutes are seeking links with many foreign institutions that can lead to new commercial products in high-technology areas.

Industrial organizations in the United States, Europe, Asia, and the Middle East, in turn, are not hesitant to search out advanced technologies throughout the FSU; and firms from dozens of countries outside the region are now engaged in joint ventures and other arrangements with advanced-technology enterprises and institutes. Countries of proliferation concern, including Libya, Iran, North Korea, and Iraq, are among the many nations that actively explore trade opportunities in

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[12] U.S. Department of State response, reflecting government-wide views, to committee questions, February 1996. See also Andrei Shoumikhen, "The Weapons Stockpiles," *Comparative Strategy*, vol. 14, no. 2, April 1995, p. 214.

[13] Richard Grimmett, *Conventional Arms Transfers to Developing Nations, 1988-1995* (Washington, D.C.: Congressional Research Service, August 1996). U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1995* (Washington, D.C.: U.S. Government Printing Office, April 1996) also cites Russian arm sales in the period 1992-1994 to such countries of western concern as Iran, North Korea, and Syria. Overall Russian arms sales, which have been increasing recently, are approximately one-third of total U.S. arms sales in 1995. However, U.S. sales are more widely distributed among many countries.

[14] Voronin, op. cit., p. 84. See also the cases of the Saratov Aviation Plant and the Central Aerohydrodynamic Research Institute in David Bernstein, ed., *Defense Industry Restructuring in Russia: Case Studies and Analysis*, (Stanford, Calif.: Center for International Security and Arms Control, Stanford University, December 1994); Victor Zaborski, "Ukraine's Niche in the U.S. Launch Market: Will Kiev's Hopes Come True?," *World Affairs*, vol. 159, no. 2, Fall 1996, pp. 55-63; Victor Zaborski, "Ukraine's Missile Industry and National Space Program: MTCR Compliance or Proliferation Threat," *The Monitor: Nonproliferation, Demilitarization, and Arms Control*, vol. 1, no. 3, Summer 1995, pp. 5-8.

Russia and other successor states.[15] That said, however, detailed information about the operation and enforcement of export controls in Russia and other successor states—as legal trade or as contraband—is not readily available. Even the publicly available Russian custom reports are presented at a level of generality that provides few insights beyond those gleaned from anecdotal reports. Nevertheless, it must be assumed that transfers of sensitive items will be a very real possibility on a sizeable scale in the years ahead.

The international export control regimes provide important guidance as to the design and operation of national mechanisms for regulating exports of many items. However, the international agreements reached in the frameworks of these regimes call for prohibitions or restrictions on transfers of only the most critical items. These agreements generally emphasize transparency of international transfers rather than proscribed limitations on exports of most weapons-related items, particularly dual-use commodities, and allow each country to decide for itself whether to authorize an export. Thus, if diffusion of sensitive items to countries of proliferation concern and to terrorist groups is to be contained on a broad basis, the international community must agree increasingly not only on the critical elements of national export control systems but also on responsible export control decision making.

In summary, U.S. policies and programs must address the dual challenges of

- supporting the establishment in the successor states of legal, regulatory, and enforcement systems that help ensure that international transfers of items on the control lists of the international regimes are subjected to governmental reviews and licensing procedures and that approvals of exports are consistent with the requirements of the regimes, and
- encouraging the successor states to ensure that the decision-making process on whether to approve exports of controlled items gives adequate weight to the international security implications of such exports.

The foregoing challenges must be met at a time when all the governments and enterprises of the region are desperate for international markets and thus frequently seek such markets in countries that may not be considered fully responsible by western governments. In such economic circumstances none of the successor states want to have regulatory systems that delay foreign sales because of excessive bureaucratic requirements. Also, Russia and, to a lesser extent, the

[15] Gary Bertsch and Igor Khripunov, "Restraining the Spread of the Soviet Arsenal: Export Controls as a Long-Term Nonproliferation Tool," in U.S. Congress, *Global Proliferation of Weapons of Mass Destruction*, Hearings before the Permanent Subcommittee on Investigations of the Senate Governmental Affairs Committee, Part II, (Washington, D.C.: U.S. Government Printing Office, 1996), pp. 665-701.

other countries will have political difficulties curtailing some trade opportunities that, in the view of the United States, contribute to the proliferation of weapons of mass destruction or otherwise threaten international security.

EFFORTS OF RUSSIA, UKRAINE, BELARUS, AND KAZAKSTAN TO ESTABLISH AND UPGRADE EXPORT CONTROL SYSTEMS

Inheritance from the USSR

Russia inherited many of the components of the export control system of the FSU. Also, the Soviet system was the only approach that was familiar in 1992 to officials of the other newly independent countries of the region.

The Soviet system was quite effective in containing sensitive commodities and information, motivated by the challenge of staying ahead of the West and the attendant need for protection of state secrets. Indeed, many items were classified as secret and simply not considered for export. Other sensitive items were firmly under the control of well-disciplined state organizations, with little possibility of leakage from the system.

All decisions on exports of militarily sensitive items were made centrally. Thus, all exports, including exports viewed with alarm by other governments, could be attributed, with a high degree of confidence, to well-considered actions by the government.

Changing Times

As Russia and the other successor states increasingly embrace industrial partnerships with many countries, even in sensitive technological areas, the former security barriers for containing items of military significance are now giving way to western-style export control systems. Such systems are intended to prevent uncontrolled diffusion of military technologies while still permitting responsible trade involving sensitive items, often at the initiative of individual enterprises, with approval by the government.[16]

The possibility of leakage of sensitive goods into international markets outside normal trade channels has become a great concern in the West. Irrespective of export controls, enterprise managers in the four successor countries are aware of the increased temptations in the region for theft; but managers who are determined to protect sensitive items have difficulty finding financial support from the government or elsewhere for industrial security upgrades. Also, there are many

[16] For some examples of sensitive exports, see Sergei Kortunov, "National Export Control System in Russia," *Comparative Strategy*, vol. 13, no. 2, April 1994, pp. 231-238.

reports of illegal practices by enterprise managers in the region who arrange for [17] Efforts to help control the spread of dangerous materials and technologies in the former Soviet Union ment of management personnel of defense-oriented firms in diversions of sensitive items cannot be ruled out. While data are not available on the extent of such activities, anecdotal evidence suggests that the likelihood of illicit diversions needs to be continuously addressed.

At the same time, the governments of the four countries have become increasingly sensitive to heightened western concerns over the possibilities of smuggling and diversions that could contribute to the proliferation of weapons of mass destruction. Government leaders have publicly espoused nonproliferation goals, and the key ministries repeatedly claim that their commitments to controlling exports are consistent with international nonproliferation norms.

However, another consideration is probably the most important factor stimulating the interest of government officials in upgrading export control systems unilaterally and through bilateral cooperative efforts. They consistently link trade and export control issues, reflecting their desires to gain recognition as responsible trading partners—an important step toward greater access to western markets and technologies.[18] Of special significance, Russia wants to be perceived as a world leader in the development and deployment of nuclear and aerospace technologies for peaceful purposes; and Ukraine seeks wide recognition for its achievements in developing technologies for applications in space programs.[19]

Also, cooperative ventures offer opportunities for additional financial resources for staff salaries and international travel and for equipment purchases.

Adopting Internationally Acceptable Export Control Systems

Many of the countries of the FSU, particularly the four countries of principal interest for this study, have started down the path of adopting export control systems that conform to the approaches developed in the West. Table 1.5 in the Executive Summary sets forth the key elements of such systems that had been identified by the members of the former Consultative Group and Coordinating Committee for Multilateral Export Controls (COCOM). These were incorporated into a "Common Standard" that was intended to be applicable to all types of sensitive exports. The Common Standard still commands broad international acceptance.

Russia has the most highly developed export control system in the region.[20] A

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[17] Discussions during the committee's visit to Russia in May 1996.

[18] U.S. Department of State response to committee questions, February 1996.

[19] Discussions with Ukrainian officials during the committee's visit in April 1996. Also, Zaborski, op. cit.

[20] See Suzette Grillot and Cassady Craft, "How and Why We Evaluate Systems of Export Control," *The Monitor*, vol. 2, no. 4, Fall 1996, pp. 11-15, for a quantitative approach showing this.

small number of officials who formerly worked in the Soviet export control system patterns and are reorienting the cadres of specialists involved in the effort.

The other countries began their programs nearly from scratch, relying primarily on new personnel with very little experience in the field. On occasion, their efforts have been plagued by turf disputes, inadequate budgets, inertia, and technical problems—the impediments to change that exist in many bureaucracies. In all countries, limitations also can be traced to a lack of experience and equipment.

Studies by U.S. government agencies and nongovernmental groups confirm the committee's overall impression that the four countries have made significant progress since the beginning of 1995 in upgrading their export control systems to meet the requirements of the Common Standard.[21] However, even after rapid progress in 1995 and 1996, in almost every aspect of the Common Standard, the four countries have a long road ahead until adequate export control machinery is in place and is operating effectively and efficiently. While Russia has the most developed system, it also faces the largest challenge.[22]

An essential element of an effective national export control system is a sound legal framework. All countries of the region are in the process of upgrading the legal bases for their activities. Russia has not yet enacted comprehensive export control legislation, although many decrees and regulations have been promulgated that provide a basis for an active program.[23] As of June 1996, Kazakstan was the only country of the four with a free-standing export control law. Belarus and Ukraine were still preparing draft legislation. Implementing regulations in these three countries were in various stages of development. At the same time, all four countries are attempting to promulgate lists of controlled items consistent with the lists of the international regimes.

In summary, each of the four countries has established or is establishing an interagency regulatory mechanism for reviewing and approving export licenses, and they are installing computerized systems for tracking applications for and action on licenses.

Enforcement: The Weak Link

The four countries have many difficulties in the enforcement area. While

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[21] At the outset the committee decided not to construct a detailed baseline for each country against which to measure their progress. This assessment of progress being made in the region is based primarily on the committee's discussions of activities under the bilateral programs.

[22] U.S. Department of State's response to committee questions, February 1996. Discussions during committee's visit to Russia in May 1996 and to Kazakstan, Ukraine, and Belarus in April 1996. Information provided to the committee by U.S. Department of Commerce specialists concerning their rating system.

[23] Gary Bertsch and Igor Khripunov, eds., *Russia's Nonproliferation and Conventional Weapons Export Controls: 1995 Annual Report* (Athens: University of Georgia, 1996).

enforcement of export control laws can never be the only line of defense against efforts to help contain the nuclear and other dangerous materials and technologies of the former Soviet Union must be sufficiently high so as to be a credible deterrent.

Much of the attention in the successor states is directed to strengthening the customs services, initially through an explosive growth of personnel and expanded training programs. In Russia, for example, customs personnel have increased from 7,000 to 54,000 in 4 years; in Ukraine from 2,000 to 17,000; in Belarus from 400 to 6,000; and in Kazakstan from 1,000 to 7,000.[24] This growth reflects the fact that the customs services are being called on to play a more extensive role in the new approaches to security as well as in collection of export and import fees. Also, the countries are faced with many international borders that previously did not exist. On the other hand, customs personnel have much less enforcement authority than counterparts in the United States.

The problem of controlling the outflow of commodities is immense. Customs facilities simply do not exist along many stretches of the tens of thousands of kilometers of frontiers, and inspection equipment, laboratory support, and automation equipment are in short supply. The training requirements are enormous. (Even in the United States, with its well-developed customs training capabilities, training opportunities are limited to 1,500 persons per year.)

Customs officials are confronted with many export and import issues. In Russia, export and import customs fees—which include taxes on exports of natural resources and imports of industrial goods—represent 20 to 25 percent of the national budget, and customs officials understandably give priority to the collection of sorely needed revenues.[25] In Kazakstan, all exports are subject to taxes, with sensitive exports being a very small part of the broader export control agenda.[26] Exports of militarily sensitive items may at times appear so complex that such matters are pushed aside in favor of more familiar activities.

Another difficulty that will not be easily overcome is susceptibility of enforcement personnel to corruption throughout the region. Salaries are very low and often delayed for several months. Thus, employees of the customs services and border guards are attractive targets for bribes by smugglers.

Recent actions of interest by the four countries include the following:

- In Russia several new decrees were issued in the spring of 1996 that clarified the procedures for addressing dual-use items and the control lists for such items. The customs service promptly strengthened its organizational structure to address different categories of controlled dual-use items, including nuclear-related, missile-related, and other items.[27]

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[24] U.S. Department of State response to committee questions, February 1996.
[25] Discussions during the committee's visit to Russia in May 1996.
[26] Discussions during the committee's visit to Kazakstan in April 1996.
[27] Discussions during the committee's visit to Russia in May 1996.

- Kazakstani officials are particularly concerned about smuggling in the Caspian Sea area and believe they have identified the principal smuggling routes in their countries and are focusing their efforts accordingly.[28]
- Belarusan and Ukrainian officials believe they have identified the principal smuggling routes in their countries and are focusing their efforts accordingly.[29]

Of course, intelligence agencies play an important role in the enforcement area. Officials in Kazakstan and Russia underscored the importance of intelligence information in anticipating and uncovering illegal operations. However, an assessment of the role of intelligence services was beyond the scope of this report.[30]

End-Use Verification

Another problem area is the limited capability of all four countries to screen the proposed end users who are identified in applications for licenses for exports of controlled items. Western governments rely heavily on data banks concerning appropriate end users and call on their embassies to assist in clarifying questionable destinations for controlled goods. They maintain a variety of black lists, gray lists, and terrorist lists. Developing accurate and up-to-date records is an expensive undertaking, and devoting resources to such activities is not of priority concern in the four countries. Russia has the strongest capability to check on the appropriateness of proposed end users, but officials acknowledged limitations in confirming end users. They added that improving the databases for end-user verification is an important need.[31]

Measuring Progress in Containing Sensitive Items

An important step in the development of an export control system is adherence to the requirements of one or more of the international control regimes. For example, Russia has agreed to internationally adopted limitations and reporting requirements on transfers of nuclear materials, nuclear dual-use items, and missile technology-related commodities. Russia has declared that its export control procedures are consistent with the policies of the Australia Group.[32] While such arrangements are certainly not a direct measure of the degree to which transfers of items of

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[28] U.S. Department of State's response to committee questions, February 1996.

[29] Discussions during the committee's visits to Ukraine and Belarus in April and May 1996.

[30] A discussion of the importance of the intelligence services is included in *The Nuclear Black Market*, Center for Strategic and International Studies, Washington, D.C., 1996.

[31] Discussions during the committee's visit to Russia in May 1996.

[32] Discussions during the committee's visit to Russia in May 1996.

[33] For a Russian perspective on this issue, specifically as it relates to the Missile Technology Control Regime, see A. V. Ustinov, "Export of Missile Technologies: Will Russia Enter the World Market?," *Comparative Strategy*, vol. 13, no. 3, July 1994, pp. 283-286.

proliferation concern have been or will be thwarted, they are important steps in a [illegible] Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies[33]

Also of considerable significance is the membership of Russia and Ukraine in the recently established Wassenaar Arrangement. They have agreed to prevent the acquisition of arms and sensitive dual-use technologies by military end users in countries whose behavior is a cause for concern. In addition, they have agreed to share information about exports covered by the regime in an effort to help ensure that such exports do not contribute to destabilizing buildups of arms.[34]

Ukraine recently joined the Nuclear Suppliers Group and declared that it is acting in accordance with the Missile Technology Control Regime's requirements.[35]

Against this evolving situation, what can be said about leakage of controlled items from the region? While there are occasional reports of successful thefts and diversions—for example, interception of missile guidance components from a storage site in Russia en route to Iraq—other contraband items may have avoided detection. Smuggling of guns and drugs is believed to be widespread, suggesting that if criminal elements should become interested in items relevant to weapons of mass destruction they might be able to use their experience with guns and drugs as a point of departure in making smuggling plans with even more ominous consequences.

Surrogate indicators of progress in controlling sensitive items are functioning regulatory systems, well-developed licensing procedures, and effective use of enforcement and interdiction capabilities. They are probably the best measures that can be developed, and conformance with the more detailed versions of these three general indicators is the essence of the Common Standard discussed above.[36]

A Regional Approach

Finally, the countries of the region began several years ago to reduce the barriers to trade in some of the successor states. Of particular significance, a

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[34] Under Secretary of State for Arms Control and International Security Affairs Lynn Davis noted this aspect in her speech at the Carnegie Endowment for International Peace in Washington, D.C., on January 23, 1996.

[35] During the committee's visit to Kiev in April 1996, Ukrainian officials complained that the U.S. Government was blocking Ukraine's membership in the Missile Technology Control Regime. U.S. officials subsequently advised the committee that, while Ukraine had become an "adherent" to the regime in May 1994, the United States continued its opposition to membership in view of Ukraine's retention of military missiles. At the same time, U.S. support for Ukraine's membership in the Wassenaar Arrangement was an indication of the willingness of the United States to recognize progress in controlling many types of sensitive technologies.

[36] Useful efforts are under way to assess the implementation of export controls in the new states of the FSU. See *Tools and Methods for Measuring and Comparing Nonproliferation Export Controls*, Occasional Paper of the Center for International Trade and Security (Athens: University of Georgia, 1996) and Grillot and Craft, op. cit., pp. 11-15.

Customs Union is being established as a step toward facilitating trade among some of the countries of the region. Border controls have been removed on the Russian-Belarus border, and eventually trade is also to flow unimpeded between Russia and Kazakstan and perhaps across other borders.[37]

Arrangements have been made to deploy a limited number of Russian customs agents on the northern, western, and southern borders of Belarus to help control items originating from or destined for Russia, and Russian customs officials are resident in Minsk and Almaty for coordination purposes, largely with regard to tax issues. Also, there are reports that Russian border guards will be deployed on the northern, southern, and western boundaries of Belarus.[38]

Of course, the trend toward the free flow of goods raises into sharp focus issues of transshipment of controlled items throughout the FSU. The international regimes prohibit reshipment of controlled items without approval of the country of origin, and this requirement is one reason that Russia has taken the lead in seeking cooperation with counterparts in almost all of the other states in the region. Such cooperation is in its early stages; Russia is initially providing Russian-language versions of the international control lists, which are not otherwise readily available, and its own regulations. Expanded cooperation directed toward exports of sensitive items seems clearly in the interest of all of the governments.

INITIATION OF U.S. PROGRAMS OF COOPERATION

Approach of the U.S. Government

In early 1992, the U.S. Government established programs of bilateral cooperation in control of exports of proliferation concern with Russia, Ukraine, Belarus, and Kazakstan. The U.S. Government has stated its overall objective of this "nonproliferation program of cooperation" as follows:

> . . . to identify a cadre of like-minded individuals in the target countries and to work with them in order to transform the general political will for nonproliferation efforts into new laws, regulations, organizations, and procedures and the competent administrative officers required to build an infrastructure . . . in all functional areas of export control systems development.[39]

The U.S. Government is looking forward to the following development as an important indicator of the success of its programs:

[37] Derek Nowek, "CIS Customs Union Develops," *BISNIS Bulletin*, International Trade Administration, U.S. Department of Commerce, October 1996, p. 1.

[38] Discussions during the committee's visit to Russia in May 1996.

[39] Provided by U.S. Department of State, September 1996.

> To have confidence that the country of concern has the capability and willingness to cooperate on a multilateral and bilateral basis in the coordination of export control policy, the investigation of suspect transactions, and the prosecution of violations of export control laws. This would allow us to classify the country as a close trading partner and to liberalize the flow of trade between our two countries.[40]

Thus, the bilateral programs were designed to encourage and support rapid development of comprehensive export control systems—to upgrade the export control "machinery" in the countries. However, a related, though less explicit, U.S. objective was to encourage responsible decision making on proposed exports of sensitive items, whether or not such exports are permissible under the international control regimes.

Implementation of the bilateral programs languished for several years because of a variety of political and administrative problems. In Washington, there were delays concerning transfers of funds to support the program among agencies and restrictions and delays on purchasing equipment for the program. In each of the four capitals, questions arose regarding the appropriateness of involvement of the United States in sensitive areas; and in Russia, problems over U.S. auditing requirements for equipment prevented the use of U.S. funds to purchase computers for the program. Finally, by late 1994, most of the problems had been overcome, and implementation rapidly accelerated.

The U.S. program's approach has been carried out by specialists from the Departments of State, Commerce, Energy (DOE), and Defense (DOD) and the Customs Service and has included the following elements:

- policy-level exchanges to emphasize the importance of enactment and enforcement of export control legislation for reasons related to nonproliferation;
- training on the essential elements of comprehensive export control laws and enforcement regulations (except Russia);
- computer automation of export control licensing procedures and provision of enforcement equipment;
- workshops on international nonproliferation export control regimes and associated control lists;
- seminars on government outreach to nongovernmental entities, and particularly manufacturing organizations, on export control and nonproliferation;
- training and equipment for supporting enforcement activities; and

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[40] Ibid.

[41] Information provided by the Departments of Commerce and Energy. For specific information on the activities of the Bureau of Export Administration, see *Export Administration Annual Report 1995 and 1996 Report on Foreign Policy Export Controls*, U.S. Department of Commerce, Washington, D.C., March 1996.

U.S.-sponsored *training* for Russian specialists was considered inappropriate given their relatively

• lab-to-lab programs, including technical exchanges, directed to nuclear-related exports.[41]

Limited efforts have also been undertaken to introduce specialists from most of the other successor countries to U.S. experience. For example, officials from the Central Asian and Caucasus states have participated in regionally-oriented overview seminars in Istanbul and Washington.

During the first four years of the program, U.S. expenditures for bilateral programs with the four countries were about $39 million from the Cooperative Threat Reduction program budget of DOD and much smaller contributions from the regular budgets of several agencies. At the request of the executive branch, Congress shifted responsibility for funding the programs to the Department of State, beginning in fiscal year (FY) 1996. During that year, Congress appropriated $10 million to the State Department's Nonproliferation and Disarmament Fund, which was earmarked for export control programs worldwide. Figure 5.1 portrays the funding situation through FY 1996; Table 5.1 outlines the general topics of U.S. government cooperative programs; and Table 5.2 identifies many of the specific activities undertaken using funds from these two sources as well as the limited funds that the concerned agencies were able to obtain through other channels.[42]

Meanwhile, the activities of other western countries in the development of export control systems in the successor states have been limited. While other governments have, of course, a major stake in success of the international regimes, including the involvement of Russia and other states in the region, they have not undertaken programs comparable to those of the United States aimed at enhancing local capabilities.

GENERAL FINDINGS CONCERNING COOPERATION IN EXPORT CONTROL

The committee considered but did not use a highly structured approach to assessing the effectiveness of U.S. efforts to support export control activities in the four countries. It was simply not possible to separate the impact of American involvement from the progress that would have been made in its absence. The

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well-developed capabilities in basic areas of export control. However, Russian specialists have actively participated in many dialogues concerning various aspects of export control and have arranged very useful visits in Russia for American specialists. As to automation, Russian sensitivities over auditing requirements for U.S-provided computers have been an impediment toward collaboration in this field. At the same time, MINATOM has decided to use a DOE-sponsored automated system to assist in processing nuclear-related export applications.

[42] Information provided by the U.S. Departments of State, Commerce, Defense, and Energy and the U.S. Customs Service.

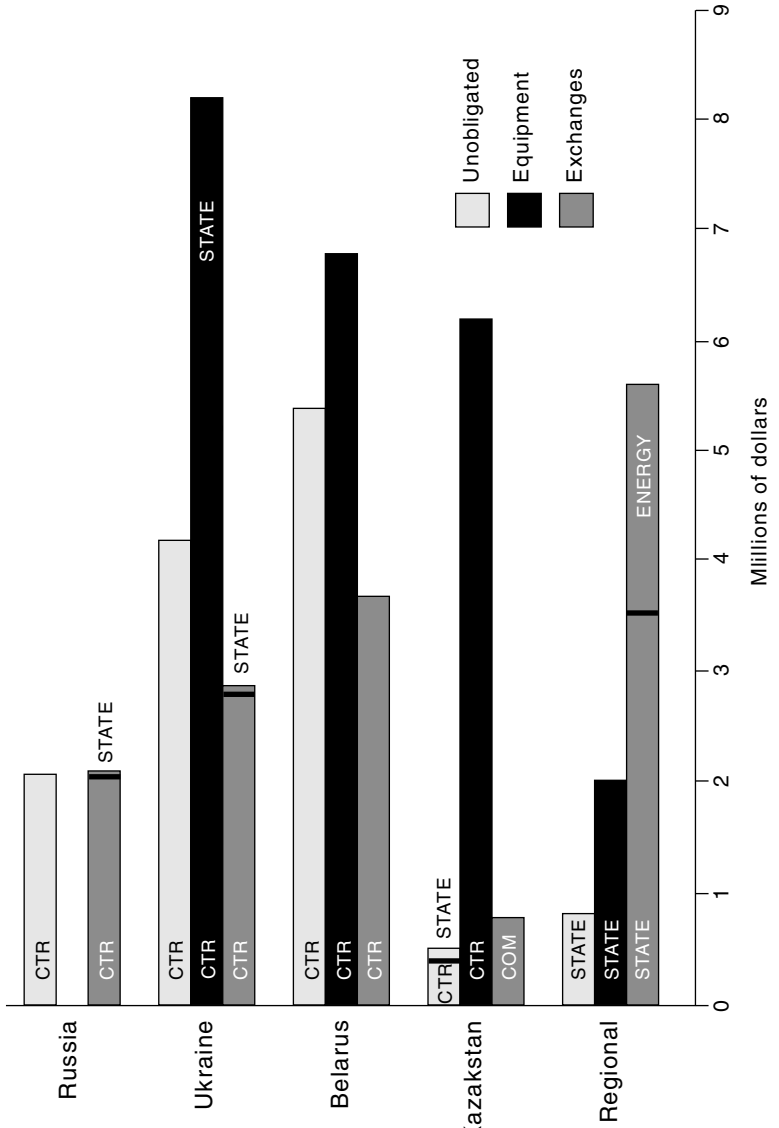

FIGURE 5.1 Funding for Export Control Cooperation (FY 1991-1996). Source: U.S. Department of State/U.S. Department of Defense. CTR, funded through the CTR program; STATE, funded through the Department of State; COM, funded through the Department of Commerce; ENERGY, funded through the Department of Energy.

TABLE 5.1 Goals of U.S. Cooperative Export Control Programs

I. National Commitment to Export Control
- Political/policy decision to adhere to international nonproliferation norms, including treaties, regimes, and embargoes.
- Responsible arms transfers (Organization for Security and Cooperation in Europe guidelines).

II. Legal Authority for Control of Exports of Munitions and Dual-Use Goods, Technologies, and Activities
- Six essential legal principles: (1) comprehensive controls, (2) implementing directives, (3) enforcement power and penalties, (4) interagency coordination, (5) international cooperation, and (6) protection of sensitive business information.

III. Licensing
- Control lists need to (1) cover international lists and national needs and (2) be clear to exporters.
- License review needs (1) complete information and (2) thorough review of all parties to transaction.

IV. Enforcement
- Preventive enforcement to reduce violations (license screening of end use/user).
- Interdiction and enforcement.
- International cooperation.

Source: U.S. Department of Commerce.

committee relied on the Common Standard to provide a qualitative baseline of activities that should be adopted in some fashion by all countries and examined how each country was measuring up in a general sense with regard to each element of the standard.

At the same time, the committee took note of efforts by both the U.S. Government and academic specialists to develop approaches for numerically rating the state of development of components of the Common Standard in the four countries as of early 1995 and late 1996. While the committee did not make its own quantitative judgments concerning the evolution of the export control systems, the observations set forth below are consistent with the preliminary quantitative efforts of others.

Strong Support in the Region for U.S. Cooperative Efforts

U.S. programs have stimulated considerable interest and action at the policy and technical levels in Russia, Ukraine, Kazakstan, and Belarus in developing effective export control systems consistent with the requirements of the international control regimes. American specialists and their counterparts have developed a high degree of mutual confidence that their joint efforts are producing

TABLE 5.2 Export Control Cooperation Activities (Led as noted by the Department of State (S), Defense (D), Commerce (C), and Energy (E), as of December 1996)

Participants from Several Countries

Export control technical forum and UPDATE conference. Washington, March 1994 (Belarus, Kazakstan, Russia, and Ukraine as well as 10 Baltic and Central European states) (C).
Export control technical forum and UPDATE conference. Washington, April 1995 (Belarus, Kazakstan, Russia, and Ukraine as well as 11 Baltic and Central European states) (C).
Export control nonproliferation forum. Istanbul, November 1995 (Kazakstan as well as 6 Central Asian and Caucasus states) (C).
Export control technical forum and UPDATE conference. Washington, July 1996 (Belarus, Kazakstan, Russia, and Ukraine as well as 12 Baltic and Central European states) (C).
Export control nonproliferation forum. Washington, September 1996 (Kazakstan as well as 7 Central Asian and Caucasus states) (C).

Russia

Laboratory-to-laboratory program between Kurchatov Institute and Los Alamos National Laboratory, December 1994 (E).
Policy consultations. Moscow, March 1995 (S).
Overview of U.S. export control system. Washington, July 1995 (C).
Industrial-government relations forum. Boston and Washington, October 1995 (C).
Orientation on Russian export control and enforcement activities. Moscow, December 1995 (S&C).
Preventive enforcement forum. Washington and Miami, March 1996 (C).
Overview of U.S. export control system follow-up forum. Washington, April 1996 (C).
Russian system orientation follow-up forum. Moscow, June 1996 (S&C).
Preventive enforcement follow-up forum. Moscow and St. Petersburg, September 1996 (C).
Nuclear nonproliferation workshop. Washington, November 1996 (E).
Industrial-government relations follow-up forum. Moscow, December 1996 (C).

Ukraine

Project development and initial technical discussions. Washington, April 1994 (S).
Continued general technical discussions. Kiev, May 1994 (S).
Orientation on automated licensing. Washington, July 1994 (C).
Assessment of Ukraine's export control system. Kiev, August 1994 (C).
Executive exchange. Washington, October 1994 (C).
Project development. Washington, December 1994 (S).
Automatic licensing system assessment, design, and verification. Kiev, February 1995 (D&C).
Automation design follow-up. Washington, March 1995 (C).
Harmonization of national and regime control lists for munitions and dual-use technologies. Washington, May 1995 (C).
Legal forum on essential elements of an export control law. Washington, May 1995 (C).
Preventive enforcement forum (enforcement techniques, prelicense and postshipment verifications, license screening, illegal acquisition indicators, and enforcement information sharing). Kiev, July 1995 (C).
Nuclear nonproliferation and industry outreach seminar. Kiev, September 1995 (E).
Policy and related consultations. Kiev, October 1995 (S).
Review of Ukrainian nuclear control list. Kiev, October 1995 (E).
Project fund allocations. Washington, February 1996.

Follow-up assessment of progress to date. Kiev, May 1996.
Technical exchange. Chicago and Los Alamos, July 1996 (E).
Laboratory-to-laboratory program in place between Argonne National Laboratory and the Ukrainian Institute for Nuclear Research. July 1996 (E).
Export control administration. Kiev, September 1996 (C).
Executive exchange. Washington, October 1996 (C).
Preventive enforcement follow-up forum. Kiev, October 1996 (C).

Belarus

Program development. Minsk, April 1993.
Assessment of export control requirements. Minsk, June 1993 (C).
Preventive enforcement forum and automation requirements assessment. Minsk, August 1993 (C).
Legal forum on essential elements of an export control law. Washington, September 1993 (C).
Orientation on licensing, enforcement, and automation. Washington, September 1993 (C).
Automation specification and project plan development. Minsk, December 1993 (C).
License processing. Washington, February 1994 (C).
Automation design. Washington, March 1994 (C).
Assessment and project development. Minsk, May 1994 (D).
Finalize automation procurement. Minsk, August 1994 (D&C).
Technical workshop. Minsk, September 1994 (E).
Automated system installation planning. Minsk, October 1994 (C).
Program development. Minsk, June 1995 (S).
Installation and certification of automated system. Minsk, August 1995 (D).
Legal and regulatory forum to review draft export control law and decrees. Washington, September 1995 (C).
Preventive enforcement and industry outreach forum. Minsk, October 1995 (C).
Automation system requirements follow-up. Washington, February 1996 (C).
Preventive enforcement and industry outreach follow-up forum. Washington and Dallas, Texas, March 1996 (C).

Kazakstan

Policy consultations. Almaty, December 1993 (S).
Program development. Washington, July 1994 (C).
Policy consultations, assessment, and program development. Almaty, November 1994 (S).
Legal forum on essential elements of an export control law. Washington, March 1995 (C).
Nuclear nonproliferation and industry outreach seminar. Almaty, June 1995 (E).
Policy consultations and program development. Almaty, June 1995 (S).
Assessment of licensing automation requirements. Almaty, July 1995 (C).
Incorporating international control lists into Kazak export control list. Washington, September 1995 (C).
Automated system design. Washington, September 1995 (C).
Preventive enforcement and industry outreach. Almaty, October 1995 (C).
Developing implementing regulations and automated system design. Washington, April 1996 (C).
Laboratory-to-laboratory program in place between Los Alamos and Argonne national laboratories and the Kazakstani National Nuclear Center. April 1996 (E).
Nuclear technical exchange. May 1996.
Automation assessment and program planning. Washington, July 1996 (C).
Drafting implementing regulations and orders (follow-up to April 1996 forum). Washington, September 1996 (C).

Source: U.S. Departments of Commerce and Energy.

important results in critical areas. The joint efforts, undertaken at a relatively low cost, have helped contain nuclear and other dangerous materials and technologies in the former Soviet Union control, training cadres of specialists in a variety of relevant fields, and installing systems for more efficient processing and validation of license requests.

The committee found that the reactions of foreign participants in joint activities were very positive, indeed almost always enthusiastic, about the programs. American specialists are repeatedly given partial credit by their foreign counterparts for many important achievements in export control throughout the region. Almost all key local officials have actively participated in the programs of cooperation, and many are in regular contact with American colleagues through a variety of channels.

However, reducing to an acceptable level the possibility of unsanctioned transfers of weapons and weapons-related items from the FSU to other states will require many years of effort at the international, national, and facility levels by governments and specialists of the four countries. The countries must be prepared to devote substantial resources of their own if they are to achieve and maintain internationally acceptable systems for export control. Building on early achievements, American specialists can continue to play an important role, and in many cases a pivotal role, in the establishment of systems that conform to the requirements of the international legal regimes. At the same time, they can provide the United States with valuable linkages to important agencies and specialists throughout the FSU.

Clearly, the U.S. effort has been effective in capturing the attention of the leaders of the four countries and in focusing cooperative activities on compliance with the international regimes. Some of the governments of the region have been accepted as members of one or more of the international regimes, as indicated in Table 1.1 of the Executive Summary. Now these governments must remain committed to the difficult task of implementing their political commitments.

Examples of Results of Cooperative Programs

The following examples of the payoffs of cooperation underscore the importance of U.S. contributions in the FSU:

- American specialists introduced Russian colleagues to the concept of internal company compliance programs, which is gradually becoming an important topic in the export control community of Russia. Table 5.3 sets forth the key elements of such compliance programs, which are being carefully reviewed by a number of key Russian enterprise managers.
- Russian customs officials are beginning to draw on the extensive experience of several U.S. agencies in developing the documentation needed to prosecute alleged violators of export control regulations.
- Kazakstan would not now have an export control law had American spe-

TABLE 5.3 Government-Industry Relations—Elements of an Enterprise Export Control Compliance Program

1. Management Policy
   - Formulate a clear and concise export control policy statement that outlines senior management's commitment to export compliance.
2. Responsible Officials
   - Identify positions in the firm that include responsibility for export control compliance.
3. Recordkeeping
   - Records kept of all export transactions.
4. Training
5. Internal Audits
   - A qualified person or team should conduct regular internal reviews to ensure that the firm's program is operating effectively and that it is in compliance with applicable export regulations.
6. Notification
   - A system should be established for consulting with the export control authority when questions arise regarding the propriety of specific export transactions.
7. Product Classification/Licensing Determination Screen
   - A system to determine whether a validated license is required for exports.
8. Diversion Risk Screen
   - Export transactions, including all the parties involved, should be reviewed for indicators of risk of diversion to an unauthorized end user, end use, or destination.
9. Sensitive Nuclear End-Uses/End-Users Screen
   - Exporters establish a system to ensure that transactions do not involve prohibited nuclear end uses or end users.
10. Missile End-Uses/End-Users Screen
    - Exporters establish a system to ensure that transactions do not involve missile end uses or end users.
11. Chemical/Biological Weapons End-Uses/End-Users Screen
    - Exporters establish a system to ensure that transactions do not involve chemical or biological weapons end uses or end users.

Source: Export Management System provided by U.S. Department of Commerce.

cialists not persuasively argued that in the long run legislation that codifies export control commitments is preferable to a series of presidential decrees that lack the same degree of permanency and may not be taken as seriously by legal institutions when resolving enforcement cases.

- In Belarus, U.S. assistance in computer hardware and software has become the basis for an automated license review system on-line, and U.S. equipment also plays an important role in interdiction and enforcement activities.
- In Ukraine, key officials are regularly drawing on their advanced training concerning U.S. licensing procedures, and effective assistance has been provided in control list development and enforcement procedures.
- In all of the countries the U.S. programs have played a pivotal role in acquainting local officials with the requirements of the international control re-

gimes and in encouraging them to develop national systems that fully reflect their own interests.

- All of the countries are developing systems that are far more open to public scrutiny than the Soviet system was, and this openness is attributable in part to American involvement in the evolutionary processes.

In short, had it not been for the active involvement of U.S. specialists in the four successor countries, it is unlikely that any of the countries would have given export control its current level of priority. Of course, they would have continued to develop less ambitious approaches to export control at a slower pace, but it is unlikely that many of the new laws and regulations, organizational structures, and review mechanisms would be in place without U.S. involvement. Also, the cadres of well-trained specialists in key positions would be significantly smaller, particularly in Ukraine, Belarus, and Kazakstan.[43]

Achieving U.S. Export Control Objectives

The United States has on occasion urged restraint by the Russian Government with regard to proposed sales of sensitive nuclear and missile-related items and advanced fighter aircraft to countries of concern, even though the sales were to be carried out in a manner consistent with the requirements of the international control regimes. It is unrealistic to expect that all export decisions will reflect U.S. perceptions of proliferation risks; however, the mechanisms established for reaching export decisions should involve those organizations in the countries that are concerned with nonproliferation.

The U.S. Government considers as perhaps the weakest link in its programs of cooperation the perception by some foreign legislators, officials, and industry representatives that export control cooperation with the West is counterproductive. Such skeptics question whether badly needed export revenue should be sacrificed to satisfy the nonproliferation concerns of the West.[44]

Export control experts from both the United States and the cooperating governments are in a position to explain to such critics and others the difference between the development of export control machinery (which all parties favor) and specific export control decisions (which sometimes are controversial). While the distinction may not satisfy foreign critics of "unwise" denials or American critics of "unwise" sales, it may help in protecting cooperation that is designed to establish needed regulatory machinery.

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[43] Discussions during the committee's visits to Ukraine, Belarus, and Kazakstan in April 1996.
[44] U.S. Department of State's response to committee questions, February 1996.

Adapting Approaches to the Local Environment

The four governments are attempting to put in place all elements of export control systems. The details of such systems need not be identical to the American approach; they should take into account the capabilities and needs of each country. For example, a very simple licensing system may be appropriate in a country where all manufacturing facilities of concern are government owned and the number of organizations authorized to export controlled items may be as small as three or four, as in the case of Kazakstan. On the other hand, special measures may be needed in some of the countries to compensate for corruption among enforcement personnel, such as multiple paths for checking on compliance. The ultimate test of an export control system is its effectiveness in carrying out the requirements of the international control regimes and not necessarily its consistency with the American approach.

An important aspect of the cooperation strategy should be the continuing emphasis on rapid "indigenization" of the programs, particularly in Ukraine, Belarus, and Kazakstan: the emphasis on programs that "train the trainers" and increasing reliance on vehicles, computers, boats, and other equipment produced locally or that at least can be serviced and maintained locally. Rapid indigenization is essential to ensure that the countries are ready in the near future to assume full responsibility for upgrading and maintaining systems that are internationally acceptable.

While the political outlook, economic conditions, industrial assets, and civil service personnel capabilities vary considerably among the four countries, the positive attitude toward working with American specialists to improve export control systems was consistent in many agencies in each country. Thus, U.S. specialists have an unusual opportunity to adapt familiar organizational and technical approaches to realities in the region and to set priorities for establishing those aspects of export control systems that are most likely to have near-term impact in containing sensitive items.

Layers of Control

Layers of control are helpful in deterring and detecting illegal exports—controls at the enterprise or institute level, checks at the customs certification and border stations, surveillance along the borders, and programs for interdiction of contraband between the foregoing control layers. At present, the primary reliance on the customs services in the enforcement area is a necessary point of departure for this approach since customs officials are involved in most of the layers. However, many other agencies also have a role to play and should be involved in cooperative efforts, including the intelligence agencies and the military and paramilitary agencies responsible for border surveillance in the four countries. Also, innovative approaches are needed for control at the source. Once an item leaves an enterprise through unauthorized channels, the difficulties of detecting it en route to a foreign destination are very severe.

Financial Viability of Key Enterprises and Institutes

A serious threat to the efforts of the United States to strengthen the capabilities of institutions in the FSU in order to curb proliferation is the continuing decline in the financial viability of the concerned enterprises and institutes. It is not reasonable to rely on unpaid or underemployed work forces to implement important aspects of export control systems, such as internal compliance programs. The need for high levels of integrity in resisting economic pressures for personal financial gain should not be placed in competition with personal survival. There is no easy solution to the massive economic shortfalls throughout the former Soviet military-industrial complex, and programs to protect sensitive items should take into account the unstable situation in these institutions.

U.S. Legislative and Organizational Framework for Cooperative Programs

Finally, the legislative and organizational approaches in Washington to developing, supporting, and implementing cooperative programs deserve greater attention. Specifically, the Defense Against Weapons of Mass Destruction Act of 1996 did not address several important aspects of export control, particularly the responsibilities of the Commerce Department, while concentrating on the role of the U.S. Customs Service. Moreover, budgetary support for export control cooperation is in constant jeopardy in the unpredictable and small budget of the State Department.

Areas for Future Emphasis

Against the foregoing background of developments in the four countries and the experience of cooperative programs to date, several areas deserve special emphasis during the next several years:

- Joint efforts should reflect the need for the four countries to *complete the infrastructure* that provides an adequate legal, organizational, and manpower base to support export control.
- The importance of the governments continuing to *strengthen implementation and enforcement* is very clear.
- Since not all aspects of export control can receive immediate attention, priorities should *focus on urgent problems*, including (a) the need to control the most sensitive items, (b) the opportunities for controlling items at the enterprise level, and (c) the importance of participation by adjacent states of the FSU in regional approaches to combat the smuggling of sensitive items.
- The protection of sensitive technical data that are subject to export control has not received sufficient attention. Preventing the diffusion of such information in some instances can be more important than containing commodities, and higher priority should be given to efforts to *control sensitive technical information.*

• An important related area is the evolution of a cadre of export control officials who can implement effective programs. Indeed, a regulatory system that operates in conformity with the procedural requirements of the international regimes but that fails to achieve outcomes that reflect a commitment to nonproliferation goals cannot be considered acceptable.

RECOMMENDATIONS TO THE U.S. GOVERNMENT CONCERNING FUTURE COOPERATION IN EXPORT CONTROL

I. Support Completion of the Legal, Organizational, and Manpower Infrastructure

Specific Finding: A starting point for controlling exports of sensitive items is a legal and organizational framework that provides the capability for policy and regulatory development, licensing activities, and enforcement. Each of the four countries is in the process of broadening and codifying the legal basis for its programs and of providing an operational system staffed with well-trained specialists. This long-term effort requires continued attention over a number of years. The United States has the most fully developed export control infrastructure of any country and is in a strong position to contribute in many ways. Over the long term, however, the four countries must assume responsibility for ensuring that improvements are sustained.

Budgetary support in the United States for bilateral export control programs needs more stability. The budget level of $10 million for FY 1996, supplemented with funds from earlier years already in the pipeline, has sustained an appropriate level of activity. Funding for FY 1997 has become quite fragmented. The Nonproliferation and Disarmament Fund of the Department of State, which was to be the central funding source for several agencies, has only $5 million for export control programs on a worldwide basis. Meanwhile, Congress has earmarked $15 million of its FY 1997 appropriation to DOD for the Cooperative Threat Reduction program for the activities of the U.S. Customs Services in the FSU. DOE has set aside funds to continue its activities. On the other hand, the Department of Commerce, which should play a critical role, has no budget line for its participation.

Recommendation: Continue to fund export control efforts in the FSU at least at the level of FY 1996 for several more years and be prepared to increase funding should particularly important high-impact opportunities arise. U.S. agencies finally have in place the international arrangements, the receptivity of key foreign counterparts, and a base of initial experience to facilitate program efforts in a number of important areas. Against this background, program activities can be broadened at little additional cost in ways that will enable American specialists to continue past activities while introducing new concepts and approaches. If Russia, in particular, unexpectedly seeks a much

higher level of cooperation, increased funding would be a very good investment, especially if it helps contain nuclear and other dangerous[45] Efforts to Help Contain Nuclear and Other Dangerous Materials and Technologies in the Former Soviet Union

Recommendation: Ensure that adequate resources are available to the Department of Commerce, as well as to the Departments of State, Defense, and Energy and the U.S. Customs Service, so that specialists with unique expertise can continue to participate in the programs. The future funding available to the agencies is very uncertain and should be put on a firmer basis. Several approaches should be considered: (a) each of the concerned agencies could seek its own appropriation for participation in the program; (b) funds could be made available to the agencies through the Freedom Support Act; and (c) if the budget of the State Department continues to be a vehicle for financing activities of other agencies, Congress should protect—through earmarking—the amount to be directed to export control activities in the FSU, and the State Department should strengthen its staff so that more serious planning and evaluation efforts associated with the funds can be carried out.

Recommendation: Emphasize in bilateral discussions at all levels the importance of developing capabilities to meet international requirements for export control and to ensure adherence to all relevant aspects of the international control regimes. Unfortunately, the topic of export control is too often considered complicated and remote from immediate problems and therefore is left off the agendas of important policy discussions. At the same time, advocates for export control in the FSU are still few in number, and they need all the political support they can obtain, particularly from their own governments. To help buffer the technical cooperation efforts from political problems, the United States should not hesitate to initiate confidential discussions through diplomatic channels to resolve misunderstandings concerning international export control issues.

Recommendation: Negotiate an intergovernmental agreement with Russia to help ensure the long-term stability of bilateral cooperation in the field of export control. Given the large stores of sensitive commodities and technical data in Russia, sustained cooperation that addresses a broad range of issues is clearly warranted. An important step in this regard is the completion of a bilateral agreement.

Recommendation: Support the strengthening of institutions in the FSU that provide training and advisory services for government agencies and enterprises involved in export control. The number of new specialists who

[45] The committee notes that multiyear funding for the bilateral programs would increase the stability and continuity of the cooperative efforts but acknowledges that U.S. congressional procedures make multiyear funding unlikely.

could benefit from training in both the general area of export control and in specialized fields is very large. Also, the technical issues involved in determining whether certain items are subject to licensing, in going through the licensing process, and then in actually shipping items abroad can be complicated for even experienced manufacturers and shippers. Of particular interest is support for the enterprises in their determinations of commodity classifications. In Russia, where many enterprises and shippers are involved, an independent Center for Export Control has been established and deserves support from both internal and external sources. Also deserving support are the specialized training and advisory units in ministries and enterprises that are expanding their export control activities.

Recommendation: Involve interested American universities and nongovernmental organizations, when appropriate, in promoting training and research related to export control that involves specialists from the FSU. Several American universities and nongovernmental organizations have been effective in promoting greater awareness of the importance and details of export control activities throughout the FSU. Funded primarily by private foundations, these organizations have provided training opportunities in the United States for individuals from each of the four countries who subsequently assumed leadership roles in their governments. The U.S. Government should draw on the resources of these organizations to help strengthen local capabilities in the successor states. They can be particularly helpful in tracking progress in implementing and enforcing laws and regulations.

II. Strengthen Implementation and Enforcement Capabilities

Specific Finding: In each of the four countries there is a considerable gap between the requirements and plans for export control activities and the implementation of effective programs for fulfilling those requirements, particularly in the area of enforcement. The role of the United States in this area has been very limited relative to the size of the problem, and activities should be significantly increased.

While U.S. efforts have been quite successful in assisting with the preparation of laws and regulatory documents, only recently have the documentation requirements for prosecution of violations become a topic for cooperation. One of the most effective deterrents to violations of export controls, at least in the United States, has been the successful prosecution of violators; and it seems likely that penalties would have an impact in the FSU. However, there are few reports of successful prosecutions in this region.

Recommendation: Continue to cooperate with counterpart agencies that have received computers and related equipment to ensure that automated

licensing and customs tracking systems are installed and used as planned. Efforts to help contain nuclear and other dangerous materials and technologies in the former Soviet Union Ukraine, Belarus, and Kazakstan concerning systems and programs that have proved to be effective in the United States. Adaptations may be necessary in the countries, and the rapid transfer of American experience both in using and in adapting the equipment and software that have been provided can be very helpful in the immediate future.

Recommendation: Expand bilateral cooperation among customs officials, emphasizing training and demonstration programs that can have multiplier effects in view of the vast responsibilities of the customs services. Despite the enormity of the task facing customs officers in the FSU, cooperation in training, advice, and demonstration equipment can help impart momentum into the much larger efforts that are needed but that are far beyond the capabilities of the United States to support directly.

Recommendation: Share with enforcement counterparts information on procedures used in the United States to collect evidence and prosecute parties found to be violating export control laws. As the criminal justice systems in the four countries continue to evolve, American specialists can be very helpful in relating their experiences concerning the detailed aspects of preparation for and carrying out of prosecutions of violators of export controls. While the legal systems in the countries of interest vary significantly from the American legal system, many techniques that have been successful in the United States should be of relevance to other countries as well.

Recommendation: Encourage high-visibility prosecutions of export control violators in the four countries so that local exporters become aware of the consequences of violations of export control laws and regulations. Attracting the attention of exporters of sensitive items through high-visibility prosecutions of violations should be particularly important in countries where in the past crimes were often overlooked if the perpetrators had strong political connections.

III. Focus on Critical Commodities, Stewardship at the Enterprise Level, and Regional Approaches

Specific Finding: In addition to supporting the development of comprehensive approaches to export control, U.S. specialists should advocate short-term strategies that focus on immediate solutions to reducing the likelihood of uncontrolled diffusion of sensitive items. In a territory as vast as the FSU, once a diverted item of concern leaves a production or storage facility undetected, its discovery becomes very difficult. Therefore, of particular importance is greater

attention to controlling the most sensitive items at the enterprises and institutes where they are produced. Efforts to help contain nuclear and other dangerous materials and technologies in the Former Soviet Union nations, including transit through neighboring countries.

American business is often far more effective than U.S. government officials in obtaining the attention of Russian enterprise officials, and the involvement of such business people in discussions of enterprise activities can be very productive.

Also, regional approaches are critical if smuggling and inappropriate transshipments of controlled items are to be checked.

Recommendation: Emphasize control of the most sensitive items by targeting educational and enforcement efforts on the organizations most likely to handle such items. Concentrating on the most sensitive items as defined in the international control lists could be an important interim step before comprehensive control systems are operating effectively. This approach would counter smuggling and diversions inspired by parties intent on obtaining weapons technologies, which presumably would include some of the most critical items.

Recommendation: Encourage the strengthening of surveillance at the enterprise level through enhanced capabilities of on-site customs officials. Customs officials are resident at many of the most important manufacturing facilities in the FSU, and officials from regional offices visit other facilities regularly. In addition to their responsibility for providing necessary documentation for shipments of authorized goods, they should play a very active role in helping to prevent unauthorized shipments from the facilities.

Recommendation: Expand interactions between officials of American companies and foreign enterprises responsible for internal export compliance programs and for industrial security and demonstrate to foreign counterparts how the U.S. private sector participates in the development of new export control regulations. The internal compliance programs of U.S. firms have already triggered considerable interest among enterprise managers in Russia. More industrial leaders from the countries should have the opportunity to appreciate the value that U.S. businessmen attach to such programs. U.S. experiences in industrial security should also be helpful to counterparts. Finally, the U.S. experience in bringing companies into export control activities from the very beginning indicates that, when business concerns are considered from the outset, misunderstandings can be avoided as to export requirements during implementation activities.

Recommendation: Encourage local officials involved in the Customs Union in the FSU to strengthen approaches for monitoring transshipments of controlled items. The impact of the Customs Union, if any, on transshipments

of controlled items is still evolving. With or without the union, the countries of Central Asia will be important as transshipment agents.

Recommendation: Participate in cooperative programs with countries of Central Asia that emphasize the importance of countering smuggling and inappropriate transshipments of sensitive items. Controlling the flow of goods across the lengthy borders of the successor states is very difficult. An important step in limiting contraband, which could include sensitive items, is a commitment by all successor states to establish programs to intercept smuggled goods as quickly as is feasible. The regional training programs supported by the United States should emphasize the threats from smuggling while giving less attention to the development of elaborate export control systems in countries that produce few controlled items.

IV. Increase Attention to Control of Technical Data

Specific Finding: Some nations and subnational groups of proliferation concern could benefit significantly from access to technical data about the design, manufacture, or integration of weapons system components. Yet this topic is receiving relatively little attention in the FSU. Russia, in particular, still protects military-classified documents. Also, the country is concerned about intellectual property. But controls over intellectual property are uncertain and are not designed to keep documents out of the hands of irresponsible parties.

Recommendation: Encourage counterparts in the four countries to strengthen national regulatory and organizational frameworks for regulating flows of technical data subject to export controls. None of the countries has established an adequate framework for addressing technical data. This complicated topic, involving many ministries and institutions from both the military and the civilian sectors, will require many adjustments of current approaches that concentrate on commodities, for both specialists from the region and American collaborators.

Recommendation: Develop and disseminate "model" technical data provisions that could be used by institutions in the FSU in contracts with domestic or foreign organizations involving controlled items. As a first step, such model provisions could be developed for and included in those contracts between American institutions supported with U.S. Government funds and Russian facilities that involve the transfer of data that are subject to export controls. While technical data concerns will vary depending on the transaction, contracts should have provisions to ensure that the requirements of the international regimes will be respected.

V. Encourage Full Consideration of Proliferation Issues in Export Control Decisions

Specific Finding: While the bilateral programs have concentrated on establishing the machinery for reaching and enforcing export control decisions, they have given less attention to the policy considerations that should underpin decisions, other than consistency with the limited requirements of the international regimes. Given economic realities, the governments of the successor states will inevitably give greater weight than would the United States to promoting trade with nations that pose proliferation risks. Until there are strong nonproliferation advocates involved directly or indirectly in the interagency deliberations, the principal inhibition on controversial exports of sensitive materials will often be external pressure from the United States or other interested countries.

Recommendation: Ensure that continuing consultations on the importance of export control activities in meeting nonproliferation objectives become an integral component of U.S. bilateral relations with the successor states in both the short and the long terms, as has been the case with relations between the United States and its traditional allies. When special program funding for cooperative activities comes to an end, the leverage of the U.S. Government on the export control activities in the successor states will diminish greatly, even though such activities will continue to have very significant national security implications. To help prevent the loss of interest in the U.S. Government in these programs, the State Department should ensure that the significance of export control is fully recognized in its future policies with regard to the successor states.

Recommendation: Promote bilateral discussions of the relationships between exports of sensitive items and proliferation concerns in many forums, at the governmental and nongovernmental levels. American specialists should repeatedly point out that, while the establishment of governmental machinery for export control is very important, the goal is prevention of diffusion of sensitive items that could cause international security problems. Therefore, each sensitive export must be considered not only from the point of view of the international "legality" of the transaction but also from the viewpoint of the national security "desirability" of the transaction.

Recommendation: Support the development of cadres of nonproliferation specialists in the FSU who have strong linkages with both policy officials in their countries and colleagues abroad. The professional capabilities and commitments of cadres of specialists are at the heart of the effectiveness of export control systems. The professional culture of such specialists should reflect a high degree of sensitivity and commitment to nonproliferation objectives.

AREAS FOR ADDITIONAL STUDY

Export control activities touch on many related areas of international security importance. Areas that deserve more detailed analysis include the following:

- *Smuggling of controlled items*. As previously suggested, greater attention needs to be devoted to interdiction of contraband material and equipment after it leaves the source undetected by responsible parties. The known histories of smuggling of controlled items and of other items such as drugs and small arms may give some insights into the problems. The interests and capabilities of organized crime to penetrate the nuclear establishments of the countries of the region needs special attention, even though the bilateral materials protection, control, and accountability programs discussed in the previous chapter should address some aspects of this issue. Also, the intelligence services and law enforcement agencies have not participated fully in the discussions of export control either in the United States or the FSU; they undoubtedly could provide important additional perspectives on the problem.
- *Controlling the borders*. Better understanding of the responsibilities, capabilities, and activities of the various units responsible for border security in the FSU should provide insight into how U.S. cooperative efforts could be most supportive in this area.
- *Controlling the export of conventional weapons*. Russia continues to sell significant quantities of fighter aircraft and other conventional weapons abroad, and several other countries of the FSU also sell limited quantities of conventional weapons abroad. A review of the inventories of armaments in the FSU available for transfers abroad and the export control aspects of sales and other transfers should help clarify the magnitude of this issue during the next several years.
- *Controlling items related to biological warfare*. While the international regime for biological agents and related equipment identifies critical items to be controlled (Australia Group control lists), development and enforcement of effective export control systems is very difficult, given the relative simplicity of the technologies involved. In this area control of technical data incorporated into documents or retained by former defense scientists is an important objective, and effective approaches to this end are needed.
- *U.S. support at key facilities*. Many enterprises and institutes that have control over sensitive items in the four countries of concern have been in very difficult financial situations for several years. At the same time, a number of American programs are supporting projects at a large number of those institutions. Greater attention should be given to how U.S. programs targeted to these institutions through many channels can be used to assist in upgrading commitments to export control, thereby counteracting to some extent the pressures to sell equipment and information that would enable the institutions to meet their payrolls. Perhaps U.S. programs that provide some financial relief to the institutions

should require certain steps at the institutions to upgrade export control compli-

- *Tracking the evolution and effectiveness of export control systems*. Documentation of the evolution of the export control systems in the region and, to the extent possible, correlating development of the systems with assessment of leakages of sensitive items from the region would be helpful in both assessing the impact of export control and providing guidance for future U.S. programs in this field.

- *Anticipating the activities of organized crime.* While there currently are no known links between the activities of organized crime syndicates and the smuggling of militarily sensitive commodities or information, the possibility of such links should be of considerable concern. Studies of organized crime activities in regions of the FSU where sensitive items are concentrated (e.g., Moscow region, St. Petersburg region, Urals) could be helpful in identifying emerging pathways for circumventing export control requirements.

- *Reducing the vulnerability of surplus sensitive items.* Given the vast quantities of surplus weapons-related items being stored in Russia (in addition to direct-use nuclear material), attention should be given to steps for reducing the number of storage sites, the security arrangements at these sites, the procedures being used for disposing of surplus items, and the ultimate disposition of selected items that have no possibility for conversion to civilian uses.

- *Clarifying the regulatory basis for controlling technical data.* For many years, balancing the need for national security restrictions on technical data exchanges with the scientific benefits from international technical cooperation has been a difficult issue. Now the situation is even more complex as electronic communications can result in rapid distribution of all types of data throughout the world. At the same time, the export control restrictions remain. A special effort to clarify the types of data that are and should remain controlled in the framework of the international regimes would be very helpful.

6

Epilogue

Advanced technologies are rapidly spreading to all corners of the globe. Many of these technologies can be great assets as the world continues to adjust to the ever-growing challenges of expanding populations, increasing demands for reliable sources of energy, dwindling agricultural lands, and escalating pressures on the limited biological resources that sustain life. At the same time, other advanced technologies can be used to threaten political stability, economic progress, and even human survival. Sometimes, the same technology can do both.

Providing security for direct-use material and limiting international flows of technologies that could be diverted to support aggression should be the common interests of the United States, Russia, and the other successor states of the former Soviet Union (FSU). In the near term, however, there will be concern about the levels of expenditures by the successor states for materials protection, control, and accountability (MPC&A) systems in light of competing demands for funds and concern over the balance between trade opportunities and national security restraint.

Sustained collaborative efforts in Russia, Ukraine, Belarus, and Kazakstan involving American specialists, however effective, cannot be divorced from the overall economic problems in the region. The many enterprises and institutes that are the repositories of the material, equipment, and technical information of proliferation concern continue to face enormous economic difficulties. Salaries, even for senior researchers, are low, and payment is often months late. The October 1996 suicide of the director of the Federal Nuclear Center at Snezhinsk

(Chelyabinsk-70) over his inability to pay his staff underscores the human dimension of the issue.

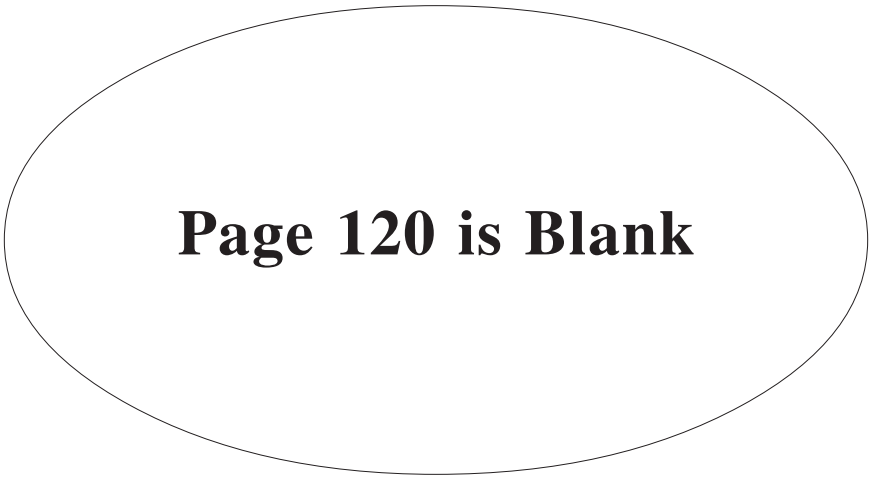
These economic realities are a major force driving the governments of the FSU, which have responsibility for their citizens' economic well-being as well as the security concerns of the international community. Their commitments and abilities to contain technological prowess therefore will be understandably fragile.

Nonetheless, the United States has come to important understandings with Russia, Ukraine, Belarus, and Kazakstan on the best approaches to MPC&A and export control. During the past several years, American specialists have been warmly welcomed by FSU colleagues attempting to contain dangerous items in the region. As vociferous political debates over a variety of divisive political issues ensue in the governments of the region, and frequently with U.S. diplomatic envoys, American and foreign specialists have continued to work hand in hand to develop practical systems that enhance security. A remarkable degree of bilateral cooperation has developed to address the core national security issues of protecting direct-use nuclear material and controlling exports of military-related items—the very items each had developed to destroy the other. Without the American involvement, it is unlikely that the growing support in the region for upgrading MPC&A systems and for adopting the objectives of the international export control regimes would be realities.

The job is far from done, however. Until the time comes when local institutions exercise adequate and responsible control over the technologies inherited from the Soviet Union (as well as discoveries in the years ahead), American specialists must play an important role in stimulating practical steps to achieve the goals of nonproliferation. Even beyond the end of U.S. Government funding for specific programs, these topics should remain a part of bilateral dialogues. Many more years of commitment and effort on the part of all of the governments is essential.

During the Cold War, the United States committed billions of dollars to counter the Soviet nuclear threat, which was well defined technically and geographically. Now, proliferation of nuclear materials has the possibility of creating a broad range of nuclear threats to the United States. This, in turn, may necessitate large increases in counterterrorism spending. It is therefore in the interest of the United States to ensure that weapons-usable material in the FSU remains under control.

In short, the need for continued progress in Russia, Ukraine, Belarus, and Kazakstan in both MPC&A and export control is great. Indeed, the national security interests of all the governments will be well served by a continuation of these relatively inexpensive programs. A small measure of cooperation now in encouraging these favorable developments may reap enormous benefits later. We should seize the opportunity.



APPENDICES

Appendix A

Overview of International Control Regimes

BACKGROUND FOR EVOLUTION OF THE INTERNATIONAL REGIMES

In the late 1940s and early 1950s, many international discussions began to focus on possible mechanisms for controlling the spread of new technologies associated with nuclear weapons. For example, the topic frequently dominated early debates of the new United Nations.

In November 1945, the three World War II partners in nuclear development—the United States, United Kingdom, and Canada—issued a joint statement of policy on the future development of nuclear energy that underscored the need for international action to both prevent the use of atomic energy for destructive purposes and promote the use of atomic energy for peaceful and humanitarian ends. This need to balance cooperation and control was reaffirmed when the International Atomic Energy Agency (IAEA) was established in 1957. The relationship between cooperation and control was given legal definition by the Treaty on the Non-Proliferation of Nuclear Weapons. The treaty, which now has 185 parties, calls for member states to restrict nuclear weapons and other nuclear explosive devices and accept controls in the form of IAEA safeguards on their nuclear activities while at the same time undertaking to facilitate the fullest possible exchange of equipment, materials, and scientific and technological information for the peaceful uses of nuclear energy for those who abide by the treaty's provisions.

As the Cold War intensified, each of the superpowers became suspicious of the intentions of its adversary regarding the development of chemical warfare

(CW) and biological warfare (BW) capabilities. In the West these suspicions led to the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous, or Other Gases, and of Bacteriological Methods of Warfare (the Geneva Protocol), which had been signed in 1925 and had entered into force in 1928. This protocol banned the use of CW and BW agents, and international attention focused on the need for stronger international measures to ban their development, production, and stockpiling.

Also in the early 1950s, the western countries joined together in the informal, but important, Consultative Group and Coordinating Committee for Multilateral Export Controls (COCOM) to help ensure that their unique military technologies were not diverted in ways that would help the Soviets and, later, the Chinese build up their military capabilities. Then, in the 1980s, several Third World nations showed increased interest in obtaining missile capabilities, raising apprehensions in many other countries. As a result, international efforts were directed to preventing the transfer of missiles, their components, and supporting technologies to countries with new military ambitions.

Against this background, a number of international regimes for controlling exports of sensitive materials, equipment, and technical information have evolved. In several areas they are well-established, providing frameworks for the efforts of countries around the world to join together in taking steps that will help prevent the spread of militarily sensitive items to countries that could then pose new threats to the international community. In other areas the regimes are still in their early stages of development.

International regulatory efforts are based largely on two types of multilateral arrangements as reflected in the regimes: (a) formal international treaties and conventions to control trade and transfers of technology in selected areas and/or to mobilize multilateral action against countries found to be violating international nonproliferation norms by undertaking inappropriate activities; and (b) less formal multilateral arrangements directed to monitoring and influencing transfers of material and technologies of concern. An essential component of all international efforts is the network of national policies and laws that reflect the international consensus on transfers of dangerous material and sensitive technologies, with the individual countries applying the consensus in controlling their own trade and related activities involving such items.

In addition, the United States and other countries, acting alone or in concert, undertake initiatives outside the framework of the established international regimes in addressing threats of proliferation of advanced weapons systems. For example, the United States can enter into a bilateral security agreement with a friendly country that feels threatened by a neighbor, and such an agreement might reduce the incentives for the friendly country to build up its own military capabilities (e.g., the U.S. agreement with Japan). Also, sanctions can be imposed by one or more governments against another government that approves exports of sensitive items to a state of proliferation concern. In the extreme, a country can

take military action against a proliferant state building up unacceptable technological capabilities (e.g., nuclear and other dangerous materials and technologies in the former Soviet Union).

Within this broad context of possible international actions, this appendix concentrates on the principal international regimes directed to the control of exports. As noted, these regimes are in various stages of development.

NUCLEAR NONPROLIFERATION REGIME

Treaty on the Non-Proliferation of Nuclear Weapons

The centerpiece of the nuclear nonproliferation regime is the Treaty on the Non-Proliferation of Nuclear Weapons, or Nonproliferation Treaty (NPT), which entered into force in 1970 and was extended for an indefinite period of time in 1995. All parties to the treaty—other than the nuclear weapons states (United States, Russia, Great Britain, France, and China)—agreed to renounce nuclear arms and accept IAEA safeguard inspections at all their nuclear installations. These inspections help assure the international community that the installations are not being used for military purposes and that fissile material is not being diverted by a state for purposes other than the peaceful uses for which it was intended. At the same time, the nuclear weapons states are obliged to engage in negotiations to end the nuclear arms race and to reduce the levels of nuclear weapons. All parties are required to ensure that exports of sensitive nuclear material and equipment will be subject to IAEA safeguards in the recipient state, whether or not the recipient is a party to the treaty. The approaches developed for the control and accounting of nuclear material pursuant to IAEA safeguard requirements are quite relevant to procedures that are appropriate for national materials protection, control, and accountability (MPC&A) programs. Of course, the purpose of the MPC&A systems installed at individual facilities is to prevent theft and illegal diversions and if they do occur to detect them quickly.

The treaty also calls for access to nuclear technology for peaceful purposes by those states that abide by the provisions of the treaty. Since such access often requires imports by states with limited nuclear capabilities of nuclear-related items from states with highly developed nuclear capabilities, the need for export control systems that address dual-use materials, equipment, and technical information is clear.

The Nuclear Exporters Committee (Zangger Committee)[1]

The Zangger Committee was formed in 1971 to establish guidelines for the export control provisions of the NPT (Article III[2]). As of the end of 1996, 31 of

[1] This information is from U.S. Arms Control and Disarmament Agency fact sheets. See http://www.acda.gov/factshee/exptcon/nuexpcnt.htm

the principal nuclear supplier states participated in the committee. The list of guards—consists of nuclear material and "especially designed or prepared" (EDP) material, equipment, and facilities normally used in peaceful nuclear programs. These are items, such as plutonium and highly enriched uranium (HEU), reactors, reprocessing and enrichment plants, and EDP equipment for such facilities, which if misused could contribute to a nuclear explosion program.

The trigger list has been updated substantially since it was first adopted in 1974 to provide more specification in key areas of the nuclear fuel cycle (i.e., enrichment, reprocessing, heavy water production). The major Zangger Committee requirements for exports of trigger list items are that they (1) not be used for nuclear explosives, (2) be subject to IAEA safeguards in the recipient non-nuclear state, and (3) not be reexported unless subject to safeguards in the new recipient state.

The Nuclear Suppliers Group[2]

The Nuclear Suppliers Group (NSG) is an arrangement of 34 nations (as of the end of 1996) that was initially formed by the United States and six other major supplier states following the 1974 nuclear explosion in India. The primary purpose was to go beyond the controls of the Zangger Committee and to involve the key non-NPT supplier, France.

The major features of the NSG Dual-Use Guidelines that go beyond the Zangger guidelines are requirements for (1) an agreement between the IAEA and the recipient state requiring the application of safeguards on all fissionable materials in its current peaceful activities ("full-scope IAEA safeguards"); (2) physical protection against unauthorized use of transferred materials and facilities; and (3) restraint in the transfer of sensitive facilities, technology, and weapons-usable materials (i.e., exports that could contribute to the acquisition of plutonium or HEU by a state of proliferation concerns). The guidelines also call for consultations among member countries on specific sensitive cases to ensure that transfers do not contribute to risks of conflict and instability.

In 1993, the NSG upgraded its fuel cycle control list and adopted an arrangement for controlling nuclear-related dual-use items. The NSG incorporated the full-scope IAEA safeguards supply condition, a long-term goal of U.S. nonproliferation efforts, into its guidelines.

The new dual-use control arrangement contains its own guidelines prohibiting the transfer of controlled items for use in a non-nuclear weapons state in a nuclear explosive activity or an unsafeguarded nuclear fuel cycle activity or when

[2] This information is from U.S. Arms Control and Disarmament Agency fact sheets. See http://www.acda.gov/factshee/exptcon/nuexpcnt.htm

there is an unacceptable risk of diversion to such an activity. To reduce the risk of diversion, the United States requires (1) specific information on how transferred items will be used, (2) stating that they will not be used for proscribed activities, and (3) stating that the supplier's consent will be obtained for any re-transfers of items.

Convention on the Physical Protection of Nuclear Material

Another relevant agreement is the Convention on the Physical Protection of Nuclear Material of 1987, which provides a basis for (a) physical protection measures during the international transport of nuclear material; (b) cooperation in the recovery and return of nuclear material stolen during international transport; and (c) criminal sanctions, including extradition, against persons who misuse or threaten to misuse nuclear material in international transport to harm the public.

Agreed minimum standards for physical protection of nuclear material in facilities are published in IAEA document INFCIRC/225, "The Physical Protection of Nuclear Materials." This document has been revised several times. These guidelines provide a standard for the technical level of acceptability of physical protection systems at the facility level, recognizing that each facility will have unique physical design and security requirements. The guidelines provide a good point of departure for the development of this aspect of overall MPC&A systems.

CHEMICAL WEAPONS REGIME

The Geneva Protocol prohibits the use of chemical weapons. The development, production, possession, and preparation to use chemical weapons, as well as their use, are to be banned under the Convention on the Prohibition, Development, Production, Stockpiling, and Use of Chemical Weapons and Their Destruction (the CW convention, or CWC). This convention will enter into force on April 30, 1997, having been ratified by 65 of the 160 signatories. The CWC had not been ratified by the United States or Russia as of the end of February 1997.

When the CWC comes into force, the Organization for the Prohibition of Chemical Weapons will be formally established in the Hague to administer the convention. The convention calls for intrusive inspections of CW stocks and manufacturing facilities capable of producing selected dual-use chemicals. Also, the convention will control transfers of CW-related substances to parties to the convention and only under stringent conditions to nonparties.

The chemicals of concern are divided into three schedules. Chemicals in Schedule 1 are those considered to be of *high* proliferation risk with very limited commercial applications. *Significant* risk chemicals with limited commercial applications are included in Schedule 2, and dual-use chemicals with broader commercial sales but that also present a risk are included in Schedule 3.

The Australia Group

In 1985, 16 industrial nations established the informal Australia Group to cooperate in curbing the proliferation of chemical weapons. Membership now stands at 30 industrial countries from around the world. The group's efforts are directed to the harmonization of export controls and the exchange of information on activities of concern. Currently, the Australia Group recommends regulations for international transfers of selected chemicals, including 54 dual-use precursor chemicals, as well as for transfers of the equipment needed to manufacture the chemicals subject to control. Each member controls the transfer of those chemicals and equipment. The Australia Group's goals are compatible with the CWC, and the group will continue its nonproliferation efforts after the CWC enters into force.

BIOLOGICAL WEAPONS REGIME

Biological Warfare Convention

The Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and Their Destruction of 1972 (the BW Convention) is the core of the biological weapons regime. It builds on the Geneva Protocol, which prohibited the use of BW agents.

The BW Convention prohibits parties from developing, producing, stockpiling, or acquiring biological weapons and from transferring relevant technologies to other countries or in other ways assisting others in acquiring such weapons. It does not include verification provisions. Also, it permits research on measures to defend against BW activities while outlawing research for offensive purposes. The dividing line between these two types of research is often very uncertain.

Australia Group

In 1990, the Australia Group expanded its efforts to include items related to biological weapons. It has recommended export control lists of microorganisms and toxins and of equipment that can be used in the production of biological warfare agents. Each member controls the exports of those agents and equipment. Specific agents in each of these categories are placed on several types of lists: the core list, the warning list, the animal pathogens list, the plant pathogens list, and the awareness list.

MISSILE TECHNOLOGY CONTROL REGIME

The Missile Technology Control Regime (MTCR) is an arrangement among countries that share a common interest in restraining missile proliferation. As of

mid-1996, there were 28 members. It does *not* link to a broadly based international effort to help contain nuclear and other dangerous materials and technologies in the former Soviet Union. While the international community has considered missiles to be legitimate weapons, the rapid spread of nuclear-capable missiles caused great anxieties in western countries and led to the establishment of the MTCR in 1987.

The MTCR develops common export control standards directed to a common list of controlled items. Members implement their commitments in the context of their own national export control laws.

The MTCR was originally designed to restrict transfers of missiles able to carry payloads of at least 500 kilograms to a range of at least 300 kilometers, including ballistic missiles, cruise missiles, space-launch vehicles, sounding rockets, unmanned air vehicles, and remotely piloted vehicles. It was assumed that (a) rudimentary nuclear warheads and their support systems would weigh at least 500 kilograms and (b) an international regime should not attempt to address short-range battlefield systems. However, following the Persian Gulf war, the MTCR was extended to cover missiles capable of delivering all types of weapons of mass destruction, particularly BW and CW weapons. The focus of the MTCR thus became the "intention" of potential recipients, regardless of the range and payload of the missile systems in question.

Each MTCR member is individually responsible for enforcing the regime's export control guidelines through its own national export control provisions, in conjunction with a common annex of controlled military and dual-use equipment and technology. The annex is divided into two sections. Category I includes those items of greatest sensitivity that could contribute to rapid missile proliferation if exported. Category II consists of a broad range of "dual-use" items.

There is a strong presumption that the export of Category I items will be denied. Production facilities for Category I systems are to be flatly prohibited.

Transfer of Category II dual-use items is permitted as long as they are subject to export controls and restraint is exercised in the consideration of such transfers. There is a strong presumption of denial for export of Category II items if intended for use in delivery systems for weapons of mass destruction.

REGIMES FOR CONVENTIONAL ARMS AND DUAL-USE TECHNOLOGIES

Overview

In late 1995, the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies was established with a secretariat in Vienna. This group of more than 30 nations includes not only the states that had been members of COCOM but also Russia and Ukraine and six countries of Eastern Europe. It has assumed international responsibility for coordinating export activities related to items previously included in COCOM's International

Industrial List and International Munitions List. As an early step, both of these lists were replaced by new ones. Meanwhile, items related to nuclear weapons (i.e., COCOM's Atomic Energy Control List) have become the responsibility of the NSG.

The Wassenaar Arrangement emphasizes responsible actions by its individual members in implementing export control laws and calls for transparency in information sharing among members for exports that are approved and denied by members.

The new organization does not provide for veto power over transfers, nor does it require prior notification of impending export decisions. However, collective examination by its members of past decisions is to provide incentives for individual states to exercise prudence in their unilateral export decisions concerning items on the organization's lists.

Since admission of new members requires consensus, the American policy that prospective members must show a record of export restraint with regard to North Korea, Libya, Iran, and Iraq in addition to meeting the formal Wassenaar criterion of acceptable national export controls and adherence to the other international control regimes makes this the de facto standard.

Conventional Arms

The Wassenaar Arrangement is designed to limit transfers of 22 categories of conventional armaments of concern. Initially data will be exchanged only on the seven categories of major weapons (e.g., main battle tanks, combat aircraft) in the United Nations Register of Conventional Arms. Since missiles are also the focus of the MTCR, they are not expected to be a priority for the Wassenaar Arrangement.

Dual-Use Technologies

The Wassenaar Arrangement also addresses a wide range of sensitive dual-use commodities that are not the subject of the other regimes.

The basic list of dual-use items incorporates most of the items previously on the COCOM industrial list. All of these items are subject to national export control procedures. A Category 2 list includes *sensitive* items, and transactions involving them are subject to information sharing as to specific decisions. All members are to exercise "extreme vigilance" with regard to a still smaller list of *very sensitive* items (Category 3).

OTHER INTERNATIONAL AGREEMENTS AND CONSULTATIVE MECHANISMS

Several arms control agreements limit the size, transfer, and deployment of weapons systems and indirectly affect export control activities. Also, bilateral consultations on proposed trade in sensitive technologies have become standard diplomatic fare, sometimes within the framework of international regimes and sometimes independent of the procedures established by them. Such consultations frequently influence export control decisions.

INTERNATIONAL REGIMES AND THE SUCCESSOR STATES

Russia and some of the other countries of the former Soviet Union recognize that their adherence to the international control regimes is important if they are to become respected participants in international security discussions and international trade activities. Therefore, it is not surprising that many are becoming actively involved in the international activities discussed above. At the same time, these countries are financially limited and frequently have difficulty even finding the travel funds for appropriate participation in meetings organized within the frameworks of the regimes.

In the nuclear area, Soviet and then Russian adherence to the NPT was of course central to the viability of that treaty. In addition, Russian specialists have been involved in IAEA activities since its founding in 1957, and many of them are well versed on the details of the nuclear nonproliferation regime. Russia was also a charter member of the NSG and the Zangger Committee.

Russia has ratified the BW Convention, and in the CW area Russian experts have participated in the development of the CW Convention since its inception. However, ratification of the CW Convention is stalled in Moscow, in part because of the high cost of destroying chemical weapons stocks that exist in the country. Russia is not yet a member of the Australia Group.

Also, Russia is a member of the MTCR and of the Wassenaar Arrangement. Ukraine is a member of the Wassenaar Arrangement and an adherent to the MTCR. Russian and Ukrainian officials are on a steep learning curve with regard to control of industrial dual-use items.

The other successor states lag in most areas. All adhere to the NPT. Belarus, Ukraine, Turkmenistan, and Estonia have signed and ratified the BW Convention. Ukraine, Kazakstan, Belarus, Kyrgyzstan, and Uzbekistan have signed the CW Convention while Tajikistan and Turkmenistan have signed and ratified it.

Further adoption by states of the former Soviet Union of the principles espoused in these and other international regimes will clearly be welcomed by western countries concerned about proliferation of technologies from these successor states. Of no less importance will be steps by the FSU states to translate the principles into regulatory practice, with effective enforcement mechanisms. Although many years or even decades will be needed to put into place some of the appropriate programs, a start has been made.

Appendix B

Site Visits and Meetings of Committee

United States

General discussions of bilateral materials protection, control, and accountability (MPC&A) and export control programs.

Department of Defense

Discussions of bilateral MPC&A programs, including the current status of MPC&A systems in the former Soviet Union (FSU) and the character and impact of U.S. activities in the region.

Department of Energy
Nuclear Regulatory Commission

Discussions of bilateral export control programs, including the current status of export control systems in the FSU and the impact of U.S. activities in the region.

Department of State
Department of Commerce
Department of Energy
Department of Defense
Customs Service

Informal views on advanced technology manufacturing capabilities in the FSU and export control issues.

Kiser Research, Inc.
Lawyers Alliance for World Security

ons, detailed aspects of bilateral MPC&A programs, export control issues in the nuclear area, and MPC&A system requirements.

Los Alamos National Laboratory
Sandia National Laboratories

Russia

General discussions of MPC&A and export control problems and the role of U.S. agencies in addressing these problems, with particular attention to nuclear smuggling.

U.S. embassy staff

Visits to facilities to become familiar with MPC&A programs that were in place and under development and to review the activities of specialists from DOE.

Kurchatov Institute of Atomic Energy (Moscow)
Institute of Physics and Power Engineering (Obninsk)
Machine Building Enterprise (Electrostal)
Luch Scientific Production Association (Podolsk)

Discussions of the design, development, and production of equipment for use in MPC&A systems.

Institute of Automatics (Moscow)
Eleron (Moscow)

Discussions of the general approaches to MPC&A at the national level, including the threat of nuclear diversions and the importance of bilateral cooperation.

Ministry of Atomic Energy of the Russian Federation
State Committee for Nuclear Protection

Attendance at an international conference devoted to all aspects of MPC&A systems and the relationships of such systems to the general issue of nonproliferation.

Kurchatov Institute of Atomic Energy (Moscow)

Discussions of nuclear contamination and nuclear safety problems, particularly problems associated with naval activities.

Institute of Nuclear Safety of the Russian Academy of Sciences (Moscow)

Discussions of the development of the export control system, relationship of the national system to international control regimes, responsibility of enterprises, problems of enforcement, and importance and impact of bilateral cooperation.

Federal Service for Currency and Export Control
Ministry for Defense Industries
Ministry of Atomic Energy of the Russian Federation
Ministry for Science and Technology Policy
State Committee for Military Technology Policy
Federal Customs Committee

Visits to facilities involved in the production and sales of dual-use items.

Khrunichev Space Production Organization (Moscow)
Institute for Radio Electronics (Fryazino)
IRE-Polus Company (Fryazino)

Seminar with Russian research institute managers on dual-use technologies under development in the fields of electronics and materials.

Russian Academy of Sciences

Seminar with Russian enterprise managers on the awareness of Russian industry as to export control requirements and steps to assist in compliance with such requirements.

Center for Export Control

Informal meetings in Moscow with Russian experts.

Seminar organized by Monterey Institute of International Studies.
Discussions with MPC&A experts from Kurchatov Institute for Atomic Energy.
Discussions with independent experts on MPC&A and export control.

Kazakstan

General discussions of MPC&A and export control problems and the role of U.S. agencies in addressing these problems, with particular attention to reducing the nuclear inventory and coping with smuggling across unguarded frontiers.

U.S. embassy staff

Discussion of nuclear problems and opportunities and the importance of bilateral cooperation.

Ministry of Science and Technology

Visits to facilities to become familiar with MPC&A programs that were in place or planned by DOE

National Nuclear Center (Almaty)
Mangyshlak Power Generation Company (Aktau)

Discussions of the development of the export control system, relationship of the national system to international control regimes, responsibility of enterprises, problems of enforcement, and importance and impact of bilateral cooperation.

Office of the President
Ministry of Foreign Affairs
Atomic Energy Agency
Ministry of the Economy
Customs Service

Belarus

General discussions of export control problems and the role of U.S. agencies in addressing these problems, with particular attention to the problem of open borders.

U.S. embassy staff

Discussions of the development of the export control system, with special emphasis on the importance of an export control law, interagency cooperation on export control, and the proliferation risk resulting from Belarus being a transit state.

Interagency meeting hosted by the Ministry of Foreign Economic Relations

General discussions of export control problems, awareness of Belarusan officials as to the risk of proliferation, and importance and impact of bilateral cooperation.

Office of the President
Minsk Central Customs
Belarus Border Guards
Institute of National Security, State Security Committee
Supreme Council Commission on Security and Prevention of Crime

Discussion of the in-country logistics support (equipment installation and maintenance) provided under the U.S.-Belarusan bilateral program.

Hughes Aircraft Systems International

Informal meetings with Belarusan experts.

International Institute for Policy Studies
Development and Security Research Institute

Ukraine

General discussions of MPC&A problems and the role of U.S. agencies in addressing these problems.

U.S. embassy staff

Visits to facilities to become familiar with MPC&A programs that were in place and under development and to review the activities of specialists from DOE.

Kiev Institute of Nuclear Research
Kharkiv Institute of Physics and Technology

Discussions of the general approaches to MPC&A and export control at the national level.

Ministry for Environmental Protection and Nuclear Safety
Ministry of Foreign Affairs, Department of Non-Proliferation, Export Controls, and Conversion
Cabinet of Ministers, Expert Technical Committee

Attendance at an international workshop on export control development and implementation, with special emphasis on the aerospace industry.

Organized by the International Institute for Strategic Studies

Informal meetings with Ukrainian experts.

Institute of International Relations, Kiev University

Appendix C

Charge to the Committee

DUAL-USE TECHNOLOGIES, EXPORT CONTROLS, AND MATERIALS CONTROL AND ACCOUNTABILITY EXTRACTED FROM DNA-NRC CONTRACT (DNA001-94-C-0182), MAY 9, 1995

(a) An NAS committee of volunteer experts shall evaluate the CTR Program's impact on export controls and regulation of dual-use technologies in Russia, Belarus, Kazakstan, and Ukraine. Particular emphasis will be given to the extent to which these controls and regulations are approaching a level compatible with western standards and those of COCOM successor regimes.

(b) The committee shall gather information required for the evaluation from DOD staff members responsible for promotion of improved export control and MC&A in the CIS. Information will also be obtained during trips to the four countries listed above. During these visits, the committee will meet with government officials who have been the focus of CTR export control efforts to date and will also make visits to selected facilities to assess implementation of the improved measures.

(c) The final report will assess the effectiveness of CTR assistance, problems in CTR assistance programs, and outstanding needs in these areas in recipient states. It will also recommend actions to the U.S. Government for future assistance programs in these areas.

Abbreviations:

CIS	Commonwealth of Independent States (includes the states of the former Soviet Union except the three Baltic States)
COCOM	Consultative Group and Coordinating Committee for Multilateral Export Controls
CTR	Cooperative Threat Reduction
DNA	Defense Nuclear Agency (now Defense Special Weapons Agency)
DOD	U.S. Department of Defense
MC&A	Materials Control and Accountability (referred to elsewhere in the broader context as materials protection, control, and accountability or MPC&A)
NAS	National Academy of Sciences

Appendix D

Biographies of Committee Members

Richard A. Meserve (*Chairman*) is a partner in the law firm of Covington and Burling. He holds a law degree from Harvard University Law School and a Ph.D. in applied physics from Stanford University. Earlier in his career he served as clerk for Supreme Court Justice Harry Blackmun and as legal counsel and senior policy analyst in the White House Office of Science and Technology Policy. Dr. Meserve has served as chair or vice-chair of a number of National Research Council boards and committees, including the Board on Energy and Environmental Systems, the Committee on Declassification of Information for the Department of Energy Environmental Remediation and Related Programs, and the Panel on Cooperation with the USSR on Reactor Safety.

John F. Ahearne is currently director of the Sigma Xi Center and adjunct professor at Duke University. He served as deputy and principal deputy assistant secretary of defense from 1972 to 1977, as deputy assistant secretary of energy from 1977 to 1978, and as commissioner of the U.S. Nuclear Regulatory Commission from 1978 to 1983 (Chairman, 1979-1981). Dr. Ahearne was also vice president and senior fellow of Resources for the Future. Prior to his current position, he served as Executive Director of Sigma Xi. He was recently elected a member of the National Academy of Engineering.

Gary K. Bertsch is the university professor of political science and director of the Center for International Trade and Security at the University of Georgia. His research focuses on the domestic and international politics of nonproliferation export controls in the former Soviet Union and Asia, a topic on which he has

published numerous books and articles. During his 25 years at the University of Pittsburgh, Dr. Cortright was awarded the University's Provost's Distinguished Service Year Award and has been designated a General Sandy Beaver Teaching Professor of Political Science. He has served as chairman of the Education Committee of the American Association for the Advancement of Slavic Studies, as an IREX scholar in the former Yugoslavia, and as a Fulbright professor in England.

Don Jeffrey (Jeff) Bostock is vice president for engineering and construction at Lockheed Martin Energy Systems, Inc. He joined the organization in 1957 at the Oak Ridge Gaseous Diffusion Plant and transferred to the Oak Ridge Y-12 Plant in 1960. Mr. Bostock's career at Y-12 included the positions of manager of the assembly and industrial engineering divisions, general manager of programs, Paducah gaseous diffusion plant manager and vice president, and Y-12 plant manager. In November 1994 he was named vice president for defense and manufacturing; he assumed his current position in July 1995. Mr. Bostock has a B.S. in industrial engineering from Pennsylvania State University and an M.S. in industrial management from the University of Tennessee. He is a graduate of the Pittsburgh Management Program for Executives.

Paul M. Doty is director emeritus of the Center for Science and International Affairs and professor emeritus of the Department of Biochemistry and Molecular Biology at Harvard University. He has been a leader in developing dialogues on security issues between Russian and American scientists. Dr. Doty was a member of the President's Science Advisory Committee and has served as a consultant to the U.S. Arms Control and Disarmament Agency and various other government agencies. He holds a Ph.D. in chemistry from Columbia University. Dr. Doty is a member of the National Academy of Sciences and has served on numerous NAS and NRC committees.

William H. Hannum *(consultant)* is director of environment, safety and quality oversight at Argonne National Laboratory. In this position he serves as the principal laboratory interface with the U.S. Department of Energy (DOE) on all safety, environmental, and quality matters. Dr. Hannum's previous positions include chairman of the Nuclear Safety Review Boards at the Tennessee Valley Authority, director of DOE's West Valley Project, and deputy director general of the Organization for Economic Cooperation and Development Nuclear Energy Agency. Dr. Hannum is a fellow of the American Nuclear Society and has served on numerous boards and committees. He holds a Ph.D. in physics from Yale University.

William G. Howard, Jr., is an independent consultant in the field of commercialization activities in private industry. Previously, he had a long and successful career with Motorola, Inc., where he served most recently as senior vice president

and director of research and development. Dr. Howard's professional experience includes service as assistant professor of materials science and engineering and electrical sciences at the University of California at Berkeley. He has served as chairman of the U.S. Department of Commerce's Semiconductor Technology Advisory Committee and the Department of Defense's Advisory Group on Electron Devices. He is also a member of the Department of Defense's Defense Science Board. Dr. Howard holds a Ph.D. from the University of California at Berkeley. He is a member of the National Academy of Engineering.

Boyd J. McKelvain is senior manager of international law and policy at the General Electric Company. He is broadly experienced in the development and management of technology in both private industry and government and is the senior GE corporate official for international trade regulation. Prior to joining GE, Mr. McKelvain served as director of nuclear energy planning and budget at the U.S. Energy Research and Development Administration and as deputy associate director for programs at the National Bureau of Standards. Mr. McKelvain is a member of the President's Export Council Subcommittee on Export Administration and chairman of the Industry Coalition on Technology Transfer. He was a member of the National Academies Panel on the Design of U.S. Export Controls and was chairman of the Federal Technical Advisory Committee on Export Regulations and Procedures.

William C. Potter is a 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 or editor of 12 books, including *Dismantling the Cold War: U.S. and NIS Perspectives on the Nunn-Lugar Cooperative Threat Reduction Program* (1997). He has served as a consultant to the U.S. Arms Control and Disarmament Agency, Lawrence Livermore National Laboratory, RAND Corporation, and Jet Propulsion Laboratory. His present research focuses on nuclear exports, nuclear safety, and proliferation problems involving the post-Soviet states. He is a member of the Council on Foreign Relations and the International Institute for Strategic Studies and serves on the International Advisory Board of the Center for Policy Studies in Russia and the International Institute for Policy Studies in Belarus. Dr. Potter was an adviser on the Kyrgyzstan delegation to the 1995 Nonproliferation Treaty Review and Extension Conference.

Alan Schriesheim served as director and chief executive officer of Argonne National Laboratory from 1984 until his retirement in 1996. Prior to joining Argonne, he had a successful career with Exxon Corporation, serving as vice president of Exxon Research Colombia, general manager of the Engineering Technology Department, and director of Corporate Research Laboratories. He is a member of the National Academy of Engineering and has served on a number

of NRC committees. He has also served on various government and industrial advisory panels. Dr. Schaich holds a Ph.D. in physical chemistry from the Pennsylvania State University.

Leonard S. Spector has been active in the nuclear nonproliferation field for nearly 20 years, working first at the U.S. Nuclear Regulatory Commission and later as chief counsel to the Senate Energy and Nuclear Proliferation Subcommittee. Since 1984, Mr. Spector has been a senior associate at the Carnegie Endowment for International Peace and director of its Nuclear Non-Proliferation Project. In 1994 he launched a new program on post-Soviet nuclear affairs based at the Carnegie Endowment's Moscow Center. He is the author of five books on the spread of nuclear weapons and recently completed the Carnegie Endowment's latest survey of the field, *Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1995.* Mr. Spector is a graduate of Williams College and holds a law degree from Yale University Law School.