U.S.-RUSSIAN COOPERATION IN THE AREA OF NUCLEAR SAFEGUARDS

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This study provides a detailed analysis of the existing problems with nuclear safeguards and material accounting in Russia by comparing the existing situation both to U.S. methods and to the system of controls that existed in the Soviet era. It also examines recent U.S. efforts under the Nunn-Lugar initiative to improve safeguards and the system of material accounting and control. Finally, it concludes with specific suggestions on how to make U.S. aid more effective and more relevant to the unique conditions hampering nuclear safeguards in Russia today.

CURRENT PROBLEMS WITH SAFEGUARDS IN RUSSIA

The Ministry of Atomic Energy (Minatom) has control of most fissile materials besides those contained in Russia's nuclear weapons.[1] To protect these materials, Minatom operates a system of internal safeguards that is functionally similar to that operated by the U.S. Department of Energy (DOE).[2] Its components include a system of physical protection, material control measures, and material accounting. Workers with access to nuclear materials have their backgrounds checked and are granted security clearances. (It is unclear whether soldiers of the guard force are subjected to background investigations.) In addition to safeguards at the facility level, Minatom runs centralized programs, such as a program of analytical measurements and standards. However, most of the centralized U.S.-type safeguards-related programs, such as a central training and qualification program, a nuclear information system, a system of regulations, are in a rudimentary stage of their development or are nonexistent.

Although Minatom's system of safeguards is functionally similar to that of the DOE, there are substantive differences in how specific safeguards programs are implemented. The principal distinction of the Russian system of nuclear safeguards is its continuing reliance on the "human factor." As a result, the system is not focused on identification of and response to all realistic diversion scenarios, and its technical sophistication is far lower than those in the United States. (For example, portal monitors commonly installed at Russian facilities are less sensitive by a factor of 20 than commercial portal monitors in the West.[3])

Probably, the most deficient component of Minatom's safeguards is the system of material control and accounting (MC&A). The system is primarily used for the purposes of material planning and financial accounting and is based on the principle of personal responsibility.[4] A designated accounting worker (*materialno-otvetstvennoye litso*) receives nuclear material and assumes personal responsibility for it. After the material has been processed in a technological operation, it is transferred to another accounting worker at the next part of the technological line. The discrepancy of the amounts of material before and after the operation is considered process loss and must not exceed centrally specified limits. Very often, because of the lack of equipment (e.g., scales), material containers that do not allow measurements, or for other reasons, material transactions are conducted without actual measurements. (There are also few shipping-receiving measurements in material transactions between facilities.) Generally, material measurements are rare and most of them are carried out as a part of a quality control program. The effectiveness of the MC&A system is also limited by the lack of regulations and by a variety of accounting formats.

Nevertheless, the system of safeguards worked well in the past. The nuclear program was manned with motivated and responsible people who took pride in being a part of the nuclear-technical elite. The industry and the state promoted this high social status through a system of special benefits. The loyalty of the personnel was further ensured by background investigations that were carried out by the KGB. In addition to the high moral standards of the nuclear establishment, there was no motivation to divert nuclear material: in the isolated Soviet society it had virtually zero monetary value.

The current crisis in Russian society has eroded the "human factor." The collapse of defense and nuclear-power orders, colossal non-payments to nuclear power plants for electricity,[5] and the inability of the state to subsidize the nuclear complex have brought nuclear workers to the brink of poverty and have resulted in economic and social insecurity. High moral standards have been further dissolved by the atmosphere of corruption and crime in the country. The reliance on the "human factor" has become a major liability for nuclear safeguards. Currently, the primary threat to nuclear materials stems from an experienced and corrupt insider (or a group of insiders) who might attempt to steal fissile materials either for profit or for political reasons or because of coercion by an external criminal organization.

The economic crisis has degraded the technical and research and development (R&D) base of the nuclear complex and its safeguards system. For example, there is a shortage of containers and adequate storage facilities for fissile materials. Also, because of the cancellation of many R&D safeguards projects and the absence of maintenance infrastructure, the necessary safeguards instruments are obsolete. In the attempt to cut corners, production facilities eliminate material-control related jobs. Meanwhile, the demands on the existing system of safeguards has increased as a result of fissile materials left over from the dismantlement of nuclear warheads.

Thus, vast inventories of nuclear materials increase the risk of diversion, and fissile materials have in fact been diverted from facilities in Russia. Kilograms of uranium with different levels of enrichment (mostly natural or low-enriched uranium (LEU)) were diverted from research centers and production plants, and fuel rods and assemblies were stolen from fuel storage facilities.

Having recognized the problem, Minatom resolved to improve the system of safeguards in the industry and to develop a national system of nuclear safeguards. The plan called for immediate improvements in the system of protection of highly-enriched uranium (HEU) and plutonium (mainly at fuel cycle facilities and weapons-production facilities) and implementation of a more comprehensive technical program aimed at developing a modern system of nuclear safeguards. For example, the objectives of the program for 1994 are to complete the development of a basic regulatory base, to set up a training center in Obninsk, and to develop radiation-detection equipment.[6] The institutional responsibilities (in Moscow) are assigned as follows:

--The Institute of Inorganic Materials (VNIINM, Director M. Solonin) has responsibility for the methodology of safeguards. The institute is the lead organization in the area of fissile materials research and on programs of measurements and certification across the nuclear fuel cycle and weapons production facilities. Its personnel are intimately familiar with nuclear material technologies and processes used by Minatom's facilities.

--The Institute of Automation (VNIIA, Director Yu. Barmakov) has responsibility for safeguards instrumentation. The institute is involved in the development of special electronic and automatic systems for nuclear weapons. It also designs physical protection and safeguards systems.

--The Institute of Management, Economics, and Information (CNIIAtomInform, Director V. Terentyev) has responsibility for the development of safeguards regulations and nuclear materials information. The institute develops and supports automated information-processing systems, hosts a central communication center with Minatom's production facilities, and provides information to the International Atomic Energy Agency (IAEA).

The safeguards activities in these three institutes are coordinated with the development of a physical protection system (the lead organization is SNPO "Eleron"). The responsibility for policy and coordination is assigned to the Committee for Safety, Environment, and Emergency Situations of Minatom (Chairman V. Gubanov).

Minatom's Council decided to upgrade safeguards in the industry in March 1993. At that time, the institutes wanted to work on safeguards projects. Unfortunately, the little money allocated by Minatom for the safeguards projects has never materialized. Since 1993, the situation in the industry has become worse. As of this writing, it is not clear whether the program can be carried out. The economic crisis, chronic delays in the payment of salaries, and neglect by the government may have already undermined the personnel and technical potential of some of the institutes. For example, the Inorganic Materials Institute is in an extremely difficult situation: its researchers have not received salaries for two months. Already many months would be necessary to resume work in the Institute; continuation of the crisis may inflict irreparable damage to the institute's research potential.

In addition, many nuclear fuel cycle production facilities do not work. The links between R&D institutes and production facilities have been severed. Thus, there is a real danger that the crisis in the industry may erode the safeguards in Russia, jeopardize plans for improved safeguards, and impair performance of the existing system.

THE NUNN-LUGAR INITIATIVE: MC&A AND PHYSICAL PROTECTION AGREEMENT

In September 1991, President Bush announced unilateral measures to reduce the danger of nuclear war and proposed to explore the possibility of technical cooperation with the Soviet Union in the areas of storage, transportation, and dismantlement of nuclear weapons. In October 1991, President Gorbachev responded by announcing plans to consolidate and dismantle Soviet tactical nuclear weapons. In November 1991, following the proposal by Senators Nunn and Lugar, the U.S. Congress enacted the Soviet Nuclear Threat Reduction Act, which provided $400 million to support Bush's initiative during fiscal year 1992.[7] As a result, the U.S. government formed an interagency group on safe secure dismantlement of nuclear weapons (SSD). The group included several sub-groups addressing different issues related to safety and security of weapons and fissile materials in the former Soviet Union.[8] One of them focused on material control, accountancy, and physical protection (MC&A/PP). (Two other groups that indirectly addressed the issues of fissile material controls, focused on fissile material containers and a central storage facility.) The relatively low priority given to the issue of MC&A/PP at that time by the U.S. government was reflected in the level of funding: only $10 million, or 2.5 percent of the Nunn-Lugar appropriations, was allocated specifically for these purposes.

Formal discussions with the Russian authorities began in March 1992.[9] In October 1992, the parties met at a technical exchange seminar in St. Petersburg. After the seminar, a group of Russian experts visited the United States in March 1993. A formal agreement on material control and accounting and physical protection was signed by Minatom and the U.S. Department of Defense (DOD) in September 1993. The agreement provided for up to $10 million of assistance over a period of five years. It was expected that most activities would take place during the first two to two and one-half years; the second part of the five-year period would be used to fine tune the program.

After the March 1993 visit of the Russian experts to the United States, the Russians formulated a request for assistance, and the U.S. experts translated the request into a draft proposal. The proposal called for cooperation in the following four areas:[10]

1. Improvement and implementation of a national regulatory program that would include a set of regulations, licensing procedures, and inspection and enforcement programs.
2. A national information system for nuclear material that would track and report on inventories of nuclear materials and transfers.
3. A technical support program that would support safeguards equipment and training requirements nationwide.
4. Model MC&A/PP systems at selected facilities that would enhance safeguards at critical fuel cycle facilities and would serve as models to be replicated at other nuclear facilities.

The principal responsibility for assistance on regulatory issues was assigned to the U.S. Nuclear Regulatory Commission; responsibility for assistance in other areas was assigned to the DOE. The Defense Nuclear Agency (within DOD) assumed responsibility for the coordination of the programs. Minatom and Gosatomnadzor were designated as recipients of assistance on the Russian side.

The parties agreed to develop a specific cooperative program at a joint technical working group meeting. Such a meeting took place in

Moscow in February 1994. Unfortunately, the results were not entirely satisfactory. The original proposal was only partially incorporated in the agenda of the meeting, which included the following: a) a regulatory oversight program; b) a model MC&A/PP system at LEU production lines of the fuel fabrication plant at Electrostal[11]; and c) a definition of requirements for a training center.[12] A site survey visit to Electrostal took place in June 1994. This visit was generally successful.

COMPLEMENTARY INITIATIVES

The ineffectiveness of the MC&A/PP agreement became apparent after the parties met in Moscow in February and April 1994. As a result, the United States started promoting a number of projects that became complementary to the SSD (now renamed CTR--Cooperative Threat Reduction) process. These included the following six initiatives:

1. Lab-to-lab cooperation. Cooperation between U.S. and former Soviet nuclear weapons laboratories began in March 1992, when the DOE and the Department of State (DOS) developed cooperation guidelines. The guidelines stipulated that cooperative projects must "provide useful work and facilitate technical exchange." Since initial exchanges in October 1992, more than 200 contracts, totaling $5 million, have been signed between U.S. and Russian weapons laboratories (there are 21 Russian and two Ukrainian institutes in Kharkov that are cooperating). Funding for cooperative projects comes from several sources: the program money of U.S. laboratories, SSD funds (exchanges on surety technologies), International Science and Technology Center (ISTC, the U.S. contribution is $25 million), and the stabilization fund ($35 million transferred from the DOS to the DOE). Cooperative projects address a wide range of scientific issues such as material science, reactor safety, and laser physics. Unfortunately, lab-to-lab cooperation involves only a very limited number of safeguards-related projects. In carrying out these projects, Russian institutes are teamed up with the U.S. national laboratories (the Los Alamos, Lawrence Livermore, and Sandia national laboratories). The projects cover such issues as environmental sampling and safeguards instruments. Only one safeguards project (on nuclear safeguards at Tomsk-7) is funded by the ISTC.

2. "Extended proposals." The U.S.-Russian Committee on Economic and Technical Cooperation, headed by Vice-President Gore and Prime Minister Chernomyrdin, has become an important mechanism to address nuclear issues, including the issue of nuclear safeguards. Direct high-level discussions create "pressure from above," resulting in political solutions to many difficult problems, as well as regular reviews of on-going projects. The United States has used the Gore-Chernomyrdin discussions to suggest a set of "extended" safeguards proposals. These include the following:

a. An MC&A/PP system for the HEU conversion and blending facility at Verkh-Neyvinsk. It is expected that the Ural Electrochemistry Plant at Verkh-Neyvinsk will be the principal facility for the conversion and blending of HEU under the U.S.-Russian HEU agreement.[13] Because of the inherent technical difficulties of safeguarding HEU, the United States has repeatedly offered to assist Russia in developing a modern safeguards system at the facility. The original proposal was to develop a model safeguards system at the facility under the MC&A/PP agreement (Nunn-Lugar funds). The Russian team responded that safeguards issues must be addressed as a part of the transparency agreement (a part of the HEU agreement). This, however, did not happen. The United States reiterated the idea within the framework of the "extended" proposals. Some $10 million was allocated for this purpose. A team of U.S. experts visited the site in April 1994. They reported that the plant's safeguards system was generally satisfactory. (However, subsequent reports were less optimistic.)

b. Near-term upgrades of nuclear safeguards at HEU/plutonium processing facilities (also known as the "quick fixes" project). The United States suggested that Minatom compile a list of critical safeguards problems at seven or eight of its HEU/plutonium processing facilities. Having received such a list, the United States would supply $10 million worth of equipment to provide "quick fixes" at these critical facilities. At the meeting in Moscow in late May 1994, the parties agreed to arrange reciprocal visits at the plutonium storage facilities at Hanford (U.S.) and Mayak (Russia). It is expected that these visits will create a methodological basis for Russian experts to assess their equipment requirements.

3. Bilateral verification arrangements proposed during the Mikhailov-O'Leary meeting in March 1994. The Joint Statement of March 16, 1994, called for re-

ciprocal inspections at fissile material storage facilities by the end of 1994 and formulated an intention to conclude an agreement on confirmation of the inventories of HEU and plutonium from dismantled weapons. The purpose of the agreement is to demonstrate the irreversibility of disarmament and to extend international fissile material control regimes to fissile materials from weapons. Presently, the parties are discussing transparency procedures.[14]

4. Conversion of research reactors to LEU fuel. The Institute of Power Engineering in Moscow (NIKIET) initiated a research program to reduce enrichment of research reactor fuel in 1978. By 1988-1989, research reactors of the two most common types (IRT and VVR) were transferred to 36 percent-enriched fuel.[15] Financial difficulties have stalled further progress. The effort is to be resumed as a result of a cooperation agreement between the U.S. reduced enrichment for research and test reactors (RERTR) program, and NIKIET and other Russian institutes and production facilities. The agreement provides for design and production of fuel enriched to 19.75 percent U^{235} for as many as 50 Soviet-designed reactors.[16]

5. NUMACS project at the Russian Research Center Kurchatov Institute.[17] Formally, the NUMACS project began in the summer of 1993, when the Kurchatov Institute signed cooperation agreements with a private U.S. company (ATI) and with Gosatomnadzor. The project objective is to develop a computerized material control and accounting system at the Kurchatov Institute. As of mid-summer 1994, the development phase was virtually completed, and the project was close to the deployment phase. The Kurchatov Institute and private American investors do not have sufficient resources to support the deployment of the system. The parties have requested Nunn-Lugar funding. The U.S. reaction was mixed: the money already had been allocated and the proposal was outside of the mainstream cooperative activities. In addition, it was pointed out that the NUMACS project has a number of drawbacks, namely, insufficient integration of the material accounting component (the focus of the project) with material control and physical protection. Nevertheless, the U.S. government has recognized the value of the project and there are indications that some form of cooperation may be worked out in the future.

6. NIS Nuclear Safety Initiative.[18] Within the framework of the Initiative, the U.S. Nuclear Regulatory Commission would assist Gosatomnadzor in developing a MC&A/PP system at Russian nuclear power plants. The project would involve site surveys as well as assistance in the area of licensing and regulations.

PROBLEMS WITH U.S.-RUSSIAN COOPERATION

Despite all of these efforts, little of a concrete nature has yet been achieved as a result of U.S.-Russia cooperation in the area of nuclear safeguards. A number of on-going problems are worth discussing in detail.

There is a lack of political momentum behind the U.S. proposals. The low-priority assigned to fissile material controls in Russia by the U.S. and Russian governments combined with the lack of high-level political leadership have made it impossible to overcome the tremendous bureaucratic inertia in both countries. The organization of the first technical group meeting provides one example of this inefficiency. The first proposal for a joint technical group meeting was cabled to Moscow in the summer of 1993. A response arrived in September 1993, and a meeting was tentatively scheduled for October 1993. Subsequently, the meeting was delayed until December 1993. A visit by Vice-President Gore to Moscow in December 1993 overloaded the U.S. embassy in Moscow and delayed the visit of American safeguards experts until February 1994. Thus, it took six months for the parties to realize this meeting. The delays have been extremely damaging to the credibility of the assistance program. They resulted in enduring perceptions within the Russian nuclear industry that the U.S. offer of assistance is insincere, that the Americans want to collect information about the Russian nuclear complex, and that the money will be spent for travel and other inconsequential purposes.

There have also been differences in views on the place of the U.S. assistance program in the development of safeguards in Russia. The principal U.S. objective has been to improve safeguards at critical defense facilities to reduce the near-term danger of nuclear proliferation. Naturally, the U.S. proposal was very ambitious and required comprehensive access to Russian facilities. At the same time, the bulk of assistance funds would be spent in the United States. The objective of the Russian safeguards authorities was to develop a comprehensive national system of nuclear safeguards. Minatom's experts assumed that any mechanical transfer of U.S.-type safeguards to Russia or isolated projects would be ineffective and counterproductive. For example, it was argued that the reliance on U.S. equipment would be unacceptable because of potential problems with spare parts and maintenance. Therefore, they argued, an effective program of U.S. assistance should be based on equipment and training support, as well as on direct financing of Minatom's safeguards projects.

A lack of U.S. sensitivity to the specific characteristics of Russian nuclear facilities is a problem as well. In Russia, the military and civilian nuclear fuel cycles are highly integrated, and many facilities are involved in both defense and commercial activities. This has been a significant problem in negotiating U.S. access to Russian facilities. For example, during the February 1994 technical group meeting, the American team suggested the development of a model safeguards system at the BN-reactor fuel fabrication line at Electrostal. This proposal was rejected, probably because the plant produces fuel for naval reactors. Similarly, naval fuel cycle activities at the Mayak reprocessing plant have created a problem of access to this facility. Reciprocity has become an absolute condition for gaining access to facilities in Russia. For example, access to the Mayak site within the framework of the "quick fixes" project was granted to the United States only under the condition of reciprocal access to the Hanford site. However, the possibilities for reciprocity may be limited, as some observers believe that there is unconditional, high-level, Russian political opposition to U.S. access to critical HEU/plutonium facilities.

The crisis in the nuclear industry may be the most serious obstacle to the implementation of safeguards assistance programs. The institutes are depleted and demoralized by chronic nonpayment of salaries. Leaders of research groups spend their time and resources procuring finances. There is a real danger that safeguards experts may leave their institutions, leaving no one to cooperate with. These processes may derail the implementation of both the Russian national safeguards program and the programs of Western assistance.

A related problem is the limited foundations for safeguards in Russia.[19] Because of the inadequate legal and regulatory provisions, the lack of technical support infrastructure, and the small number of safeguards experts, it is difficult for Russia to process and respond to (let alone implement) ambitious U.S. proposals. In part, this explains the Russian requirement for a slow, step-by-step approach to cooperation.

There is also a problem of coordinating activities with Euratom and European countries. For example, the DOE-developed project on a national information system lost its significance when the Russian authorities decided to adopt a Euratom-type national information system.

Finally, some believe that the United States has made a mistake by focusing on cooperation with Minatom because of the tremendous bureaucratic inertia and corporate interests of this agency, and because a significant fraction of fissile materials (e.g., fuel for naval reactors and materials in nuclear weapons) is not in Minatom's custody. Therefore, they argue, the bulk of assistance should have been directed towards Gosatomnadzor, the regulatory agency which supervises safety and safeguards of all fissile materials in Russia.

This view is opposed by others on the following grounds:

--Virtually all difficult-to-safeguard bulk materials are owned by Minatom.

-- Minatom operates and is intimately familiar with virtually all facilities that are of primary interest for the U.S. assistance program.

-- Minatom operates a preventive internal safeguards system. (Most safeguards experts at Gosatomnadzor have IAEA background and may have insufficient expertise in organizing a system of internal controls.)

-- Minatom has powerful technological and human resources bases to implement the project.

-- Ignoring Minatom would result in a counterproductive power struggle.

CONCLUSION

In 1992-93, the United States had a window of opportunity to improve nuclear safeguards in Russia. The idea of U.S.-Russian cooperation was new and attractive, and the Russian safeguards infrastructure was relatively intact and capable of achieving results. The lack of political momentum at that time, bureaucratic inertia, and an unwillingness to carry out a reciprocal program have stalled the effort. U.S. mistakes were compounded by the bureaucracy, political instability, limited safeguards infrastructure, and sensitivity of many fuel cycle facilities in Russia.

Recently, the U.S. government has

come to realize the importance of assistance to Russia in the area of nuclear safeguards. Indeed, the situation with regard to fissile material security in Russia has become worse. However, the window of opportunity may have already been closed by political difficulties and by the crisis of nuclear institutions in Russia. Under these conditions, the objectives of the U.S. assistance program should include the following: a) preservation and strengthening of the safeguards infrastructure in Russia; b) improvements in prospects for long-term cooperation; and c) increased security of HEU/plutonium at some critical facilities in the near term. In order to achieve these objectives, it might be advisable to examine the benefits of intensifying activities in several areas (but this should not be done at the expense of other successful on-going projects).

One such initiative should be the immediate stabilization of the key safeguards-related institutes and production facilities in Russia.[20] Stabilization efforts should include the following steps: a) the identification of such institutes, as well as safeguards groups and individuals within them; b) the identification of potential safeguards-related projects that might be offered to these groups; and c) direct contractual arrangements with safeguards groups. The lab-to-lab cooperation and ISTC projects are probably the most suitable (if not the only) instrument available for such a stabilization effort. Lab-to-lab and ISTC projects have also been relatively successful in delivering money directly to research groups within nuclear institutes. (It would be difficult but not impossible to avoid significant diversion of money to other institutes or to non-safeguards groups within the same institute.) Direct financial assistance would preserve the technological and personnel potential for safeguards in Russia (which might be the most important task of the day), significantly improve the perception of the U.S. assistance at the working level, help to build trust in the relations between the partners, and facilitate practical results in the development of safeguards systems and technologies.

A second urgent task is the continuation of high level political discussions (including Gore-Chernomyrdin meetings) on a commitment by the Russian government to cooperate on safeguards issues. This might require significant reciprocity from the United States.

Long-term cooperative projects with institutions outside of Minatom, including Gosatomnadzor, Kurchatov Institute, and other agencies owning nuclear materials or operating nuclear facilities must also be promoted.

Finally, the U.S. should be willing to provide safeguards equipment to improve the containment of nuclear materials. In most recent diversions, nuclear materials were carried out, thrown out of windows, or removed from facilities in a similarly straightforward fashion. Therefore, provision of equipment to provide reliable containment of nuclear materials (e.g., containers, locks, and access control devices) and to block principal diversion routes (e.g., portal monitors) might be a significant contribution to the security of fissile materials. (The program of "quick fixes" appears to be best positioned for such equipment transfers.)

Overall, the key to success in implementing better nuclear controls in the midst of Russia's current crisis is close contact with the specific problems facing Russian nuclear facilities and nuclear scientists. Only with this knowledge and the cooperation of Russian specialists responsible for nuclear materials will U.S. initiatives be able to succeed.

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[1] Some material is in the custody of other agencies (e.g., the Ministry of Shipbuilding and the Committee for Defense Industries) and research centers (e.g., Russian Science Center Kurchatov Institute). Safeguard supervision and regulation are carried out by Gosatomnadzor, the Russian nuclear regulatory agency.

[2] The primary functions of internal safeguards are to deter, prevent, detect, and respond to unauthorized possession, use, or sabotage of weapons-usable materials.

[3] V. Kositsin, A. Shumakov "Increase in Reliability of Control of Unauthorized Movement of Small Amounts of Fissile and other Radioactive Materials", *Atomnaya Energiya*, 75 (August 1993), pp.103-108. The industry uses portal monitors of RZG-04 type; more sensitive equipment is in the first stage of development or pilot production.

[4] In some cases, additional material control measures, such as implementation of the two- or three-man rule, are employed. This is also done for safety reasons.

[5] As of the summer of 1994, the ratepayer debt to the state nuclear utility Rosatomenergo amounted to 780 billion rubles. (Ignatenkov, presentation at the Nuclear Society Conference, Obninsk June 27 - July 1, 1994.)

[6] A. Sviridov, presentation at the Nuclear Society Conference, Obninsk June 27 - July 1, 1994.

[7] The legislation was amended in 1992 and 1993, and the funding level was increased to $1.2 billion.

[8] Originally, the group included seven sub-groups on 1) kevlar armored blankets; 2) disposition of HEU and plutonium from weapons; 3) fissile material containers; 4) transportation of nuclear weapons; 5) fissile materials storage facility; 6) MC&A/PP; and 7) accident response equipment and training. Additional sub-groups have been formed since then.

[9] An informal request for assistance was made by Gosatomnadzor in October-November 1991.

[10] A detailed analysis of the original proposal and the history of cooperation are provided in: P.Ting, M.Kelly, S.Caudill, and R.Cherry "United States Support to the Republics of the Former Soviet Union," proceedings of the 1993 Institute of Nuclear Materials Management (INMM) meeting, pp.569-573.

[11] The Russian team suggested the development

of model systems at the natural uranium UF6 plant at Angarsk and low-enriched uranium (LEU) fuel fabrication plants at Novosibirsk and Electrostal. The U.S. group rejected Angarsk because of the minimal proliferation concerns associated with this facility. Instead, the U.S. group suggested the development of model systems at the HEU production line at Electrostal (producing fuel for BN-type fast reactors) and at the Verkh-Neyvinsk HEU conversion and blending facility. This suggestion was rejected. Finally, the sides agreed to build model systems at the LEU fuel production lines at Electrostal and Novosibirsk. Later, the United States dropped the Novosibirsk site in order to avoid duplicate systems.

[12] The Russian side declared an intention to develop a training center in Obninsk. It suggested that this might be a joint Russia-U.S.-Euratom project.

[13] According to the U.S.-Russian HEU agreement, the United States will purchase approximately 500 megatons of Russian HEU from retired weapons. Over a period of 20 years, HEU will be blended down to LEU to be fabricated into fuel for commercial nuclear power reactors. It is expected that most conversion and blending will take place in Russia.

[14] One proposed inspection regime includes the following stages of verification: a) site familiarization; b) confirmation of material presence; c) confirmation of plutonium presence; d) confirmation of presence and mass of plutonium; and e) confirmation of presence of weapons components. Steps d) and e) would reveal weapons design information and require amendment of the Atomic Energy Act (Section 142).

[15] Past reductions were made on the basis of high-density Al-dispersed fuels. Future progress will involve silicide-technology fuel. (*Nuclear Fuel*, December 6, 1993.)

[16] Probably only one half of these reactors are operating at present.

[17] NUMACS stands for the Nuclear Material Accounting, Control, and Safeguards project.

[18] The Nuclear Safety Initiative was proposed by Secretary of State Baker in Lisbon in May 1992. Subsequently, the commitment was increased during the Clinton-Yeltsin summit in Vancouver (August 1993). According to the initiative, the U.S. Agency for International Development would provide funding for DOE, NRC, and BNL to increase safety at nuclear power plants in Russia and Ukraine.

[19] Ron Cherry, Presentation at INMM meeting on April 7, 1994, in Washington, D.C.

[20] Candidates for assistance may be drawn from the following groups of facilities:

-- R&D and production facilities in the area of safeguards instrumentation (e.g., VNIIA, VNIINM, Arzamas-16, and Chelyabinsk-70);

-- Groups specializing on analytical measurements: VNIINM (the Laboratory of Standards), Institute of Chemical Technologies (Moscow), Radium Institute (St.Petersburg), Institute of Atomic Reactors (Dimitrovgrad), and Institute of Power and Physical Engineering (Obninsk);

-- Physical protection institutes (SNPO Eleron, Arzamas-16, and VNIIA).

-- Groups working on facility-level safeguards systems (e.g., Tomsk-7, and the Institute of Power and Physical Engineering in Obninsk) and specific safeguards projects (CNIIAtomInform, Kurchatov Institute).