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Russia's Nuclear Security Policy:
Priorities and Potential Areas for Cooperation

The crisis over Ukraine has led to a drastic reduction in regular official Russian-US contacts in most areas, including those where it is in the two countries' mutual national security interests to work together. Bilateral cooperation on nuclear nonproliferation and nuclear security has been among the affected areas.

The United States has suspended contacts with Russia in the framework of the G-8 and in the Russian-US Bilateral Presidential Commission's Nuclear Energy and Nuclear Security Working Group. Implementation of the September 2013 agreement on Cooperation in Nuclear- and Energy-Related Scientific Research and Development (R&D Agreement), which prioritizes joint efforts on nuclear nonproliferation and nuclear security, has also been put on hold, and exchanges between nuclear scientists of the two countries have been frozen. In turn, Russia has decided not to take part in preparations for the 2016 Nuclear Security Summit. Moscow also notified Washington that most of the joint nuclear security projects in Russia would not be extended beyond December 31, 2014.

This trend is a serious cause for concern, given that Russia and the United States, which are depositaries of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), bear special responsibility for maintaining the effectiveness of the nuclear nonproliferation regime. In the current political situation, the prospects for closer Russian-US nuclear cooperation, including efforts to strengthen the nuclear security regime, will depend on the two countries' ability to incorporate such cooperation in the shifting framework of their bilateral relations and to overcome the differences in their priorities.

Russia places heavy emphasis on the development of nuclear energy—with simultaneous efforts to upgrade various elements of the nuclear security system as dictated by the changing challenges and threats—and dealing with the problems of nuclear legacy. The latter priority includes resolving the problem of the accumulated stockpiles of spent nuclear fuel, the decommissioning of power reactors and research facilities that have reached the end of their service lives, and disposal of weapons-usable nuclear materials that are surplus to national defense requirements.

Globally, Moscow's top priorities include facilitating the development of the nuclear security infrastructure in the nuclear newcomer countries that are planning to build nuclear power plants (NPP) using Russian technology, and

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addressing nuclear legacy issues in countries that operate nuclear facilities built with Soviet assistance.

In these circumstances, if Moscow and Washington manage to overcome the structural obstacles to bilateral cooperation, they could work together in several areas that are directly relevant to nuclear security. To make such cooperation possible, the following will have to be done:

- Reverse the ongoing process of closure of the existing channels of cooperation on the entire range of nuclear and nonproliferation issues. Both sides must incorporate bilateral nuclear cooperation in the changing framework of bilateral relations and make sure that this dialogue is unaffected by any restrictions on bilateral contacts.

- Create a new model of mutually beneficial and equal cooperation, something Russia and the United States have failed to do. That new model must take into account, in equal measure, the two countries' nuclear energy and nuclear security priorities.

- Make the U.S.-Russian Agreement on Cooperation in the Field of Peaceful Uses of Nuclear Energy (123 Agreement), the R&D Agreement, and the Framework Agreement on Multilateral Nuclear Environmental Programme in the Russian Federation (MNEPR) as well as its June 2013 Russian-US Protocol central elements of the legal framework for bilateral cooperation.

- Prioritize projects that already have the necessary legal framework, since that allows joint efforts to be launched without delay. In particular, the two sides must accelerate the implementation of the Russian-US Plutonium Management and Disposition Agreement. A lack of significant progress over the next two to three years on this first-ever international document that regulates the disposal of weapons-grade plutonium could bury the agreement.

- Consider initiating joint projects to support implementation of the Russian federal target program called Nuclear and Radiation Safety for 2016–2020 and up to 2025, which includes nuclear legacy projects and emphasizes strong nuclear security. The program clearly demonstrates that Russia and the United States often have similar priorities, but for various reasons (including historical ones) they implement the same types of projects under different umbrellas. For example, the United States regards the removal of spent highly enriched uranium-based research reactor fuel as one of its nuclear security priorities. Russia is planning large-scale and costly projects to remove all spent fuel from research reactors, but it views these projects as part of the nuclear safety effort.

- Consider creating commercial incentives for joint projects between the two countries' nuclear industries that would be relevant in terms of nuclear security. Ending the use of highly enriched uranium (HEU) in the production of medical Mo-99 isotopes is one of the most obvious and urgent areas where commercial incentives could be applied in the Russian-US cooperation context.

- Identify areas of cooperation in third countries where Russia and the United States have shared interests rather than compete with each other. To secure broad support for such joint efforts amid the ongoing crisis in bilateral relations, there should be more emphasis on cooperation with the expert community and the mass media.

Background

Russia regards nuclear energy and nuclear technology as a key components of its strategy for economic development. Apart from meeting the Russian economy's growing energy demand, the objectives include shifting the energy industry's emphasis from fossil fuel production and transportation to advanced nuclear and related nonnuclear technologies, and exporting high-tech energy products rather than raw materials. Nuclear technologies have been designated as one of the five priority areas of technological modernization of the country's economy.

Russia has one of the largest NPP fleets in the world, with 33 nuclear power reactors in operation. The government wants the output of Russian NPPs to double by 2035, and the share of nuclear energy to reach 22 to 23 percent of electricity generation.[2] In addition, Russia is among the largest nuclear exporters in the world, with $5 billion worth of annual exports. It supplies foreign customers with enriched uranium, nuclear fuel, and medical isotopes. It also builds NPPs in foreign countries using Russian reactor technology.[3] As of late 2014, the Russian state-owned nuclear energy corporation Rosatom had more than $100 billion worth of export contracts in its portfolio for the next ten years.[4]

In this context, an adequate and reliable global nuclear security regime amid the persistent terrorist threat is seen as a crucial component of nuclear energy development and the use of nuclear technologies both domestically and in foreign markets. As far as export projects are concerned, one of the most worrying trends is the rise of the Islamic State, which Russia regards as a terrorist organization, in the Middle East. That rise creates new challenges to the security of the existing nuclear facilities and to the implementation of new projects to build NPPs and research reactors in the region.

In the late 1990s and the 2000s, Russia implemented extensive efforts at home that have enabled it to set up a comprehensive national nuclear security system. That system encompasses the nuclear industry and its personnel (over 1 million people in 1991, and about 250,000 in 2013).[5] While that system was being formed, Russia faced a major

terrorist threat from rebels in the North Caucasus that were supported by international terrorist groups.

The nuclear security system Russia has put in place includes a legislative and regulatory framework, a national nuclear material control and accounting system, a system of physical protection of nuclear materials, a system of personnel training and certification, and the training centers and facilities necessary for nuclear personnel to develop practical skills. Given the size of the Russian nuclear industry and the scale of these objectives, achieving them in a relatively expeditious fashion was made possible by active international cooperation.

To a large extent, the nuclear security-related risks were minimized by ending the production of weapons-usable nuclear materials (HEU and plutonium). These materials are the most coveted target for terrorist organizations. Russia also substantially reduced its existing stocks of HEU. As part of the 1993 Agreement Concerning the Disposition of Highly Enriched Uranium (HEU Purchase Agreement), more than 500 metric tons of HEU extracted from nuclear weapons was converted into fuel for US nuclear power plants in 1995–2013, using an economically effective mechanism.[6] It is worth noting that Russian officials regard the HEU Purchase Agreement primarily as part of the irreversible nuclear disarmament effort. That program's contribution to bolstering nuclear security is therefore seen in Moscow as a useful corollary of fulfilling Russian nuclear disarmament commitments.

As part of the 1993 HEU Purchase Agreement, more than 500 metric tons of HEU extracted from Russian nuclear weapons was converted into fuel for US nuclear power plants in 1995–2013.

At this time, the main nuclear security objective is to further upgrade the already existing infrastructure, taking into account the emerging new challenges and threats, the accumulated experience of Russia and other countries in operating nuclear security systems, and the expertise of the International Atomic Energy Agency (IAEA). For example, Rosatom has approved various facility-specific programs and plans to improve physical protection systems. These programs, which are expected to run until 2020, will be adjusted on a regular basis to reflect the findings of interagency inspections and exercises conducted by Rosatom in cooperation with the Federal Security Service, the Interior Ministry, and the Emergencies Ministry.[7]

Another important objective is to optimize that infrastructure so as to reduce various risks and operational costs. This largely has to do with the need to eliminate the vast nuclear legacy Russia inherited from the Soviet nuclear industry. That legacy includes the stockpiles of spent fuel at nuclear power plants and nuclear research facilities. This spent fuel needs to be reprocessed and the resulting nuclear waste disposed of safely. Russia also needs to decommission numerous nuclear facilities and buildings, including research reactors and critical and subcritical assemblies that are no longer needed; rehabilitate contaminated territories; and, in a way that makes economic sense, dispose of weapons-grade nuclear materials designated as surplus to national defense requirements.

Improving National Legislation and Regulation

It is first useful to review the key principles of Russia's nuclear security policy and recent efforts at improving the Russian legislative and regulatory framework.

The scope of nuclear security comprises a broad range of issues, including physical protection of nuclear material, facilities, and radiation sources; protection of information about these materials and facilities; nuclear material control and accounting; nuclear material security during transportation; a system of detecting and investigating any illegal activities involving nuclear materials;

and effective response and relief efforts in the event of any accidents involving nuclear materials or radiation sources.

The key principles of Russian nuclear security policy are:

- The global nuclear security regime can be effective only if every country has an effective and adequate nuclear security system at the national level.
- The full extent of responsibility for ensuring efficient nuclear security within a state lies with its national government.
- Participation in the key international nuclear security and nuclear counterterrorism agreements—the Convention on the Physical Protection of Nuclear Material (CPPNM) and the amendment to that convention, as well as the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)—is important to strengthening the national nuclear security infrastructure and building international confidence in the area of nuclear security.
- Assistance to other countries in the area of nuclear security can be provided at their request and in accordance with their national laws.
- The central role in coordinating international nuclear security cooperation should belong to the IAEA; however, nuclear security of materials and facilities used in military programs is not part of the agency's remit.
- International nuclear security cooperation must not lead to disclosure of sensitive information about national nuclear security systems.[8]

Russia's systemic effort to improve its national legislation and regulation in the area of nuclear security makes use of the existing experience and domestic expertise, best practices in foreign countries, and IAEA expertise.

Russia pursues a systemic effort to improve its national legislation and regulation in the area of nuclear security, including the physical protection, control, and accounting of nuclear materials. That effort makes use of the existing experience and domestic expertise, best practices in foreign countries, and IAEA expertise. Here are some of the recent documents approved by the president, the Cabinet, and individual ministries and agencies with the aim of improving Russian nuclear security arrangements:

- On July 19, 2007, the Cabinet issued a resolution approving an update to the *Guidelines for Physical Protection of Nuclear Materials, Nuclear Facilities, and Nuclear Material Storage Sites*. The new document superseded the guidelines adopted in March 1997.[9] Incremental updates are approved annually by Cabinet resolutions.[10]
- On March 18, 2009, the Federal Environmental, Industrial and Nuclear Supervision Service (Rostekhnadzor) issued Order No. 169 enacting the *Procedure of Assessment of the Level of Security Culture at Nuclear Fuel Cycle Facilities (RB-047-08)*. That document introduced guidelines for conducting internal appraisal of the skills and psychological preparedness of personnel in the area of security at nuclear fuel cycle facilities.[11]
- On March 11, 2010, the Ministry of Natural Resources approved a set of federal norms and regulations pertaining to the use of nuclear energy, *Requirements to Physical Protection of Ships Equipped with Nuclear Propulsion Systems or Carrying Nuclear Materials (NP-085-10)*. The document contains requirements for providing nuclear security on ships equipped with nuclear reactors, specialized ships that transport nuclear materials and radioactive waste, and nuclear maintenance ships that transport, store, and transship nuclear fuel.

- On April 17, 2012, Rostekhnadzor issued Order No. 255, *Main Guidelines for Nuclear Material Accounting and Control*. The document contains more detailed requirements for nuclear material accounting and control depending on the category of nuclear materials.[12]

- On February 13, 2014, as part of the effort to improve regulatory and supervision arrangements in the nuclear weapons industry, including nuclear material security provisions, the Russian president issued Decree No. 79, *On Setting Up a Federal State Supervision System in the Area of Nuclear and Radiation Safety of Nuclear Weapons and Nuclear Facilities Operated by the Military, and in the Area of Physical Protection of Nuclear Materials, Nuclear Facilities, and Nuclear Storage Sites at Nuclear Facilities*.[13]

- On March 4, 2014, to improve the effectiveness of supervision in the area of physical protection at civilian nuclear facilities, Rostekhnadzor issued Order No. 89, On *Approving the Standard Program of Targeted Inspections of Physical Protection Arrangements for Nuclear Materials, Nuclear Facilities, and Nuclear Material Storage Sites*. The document outlines key provisions for inspection of physical protection of nuclear materials, nuclear facilities, and nuclear material storage sites.[14]

The experience and expertise accumulated during the formation of the nuclear regulatory system in Russia is being put to good use as part of training programs, including those conducted in cooperation with the IAEA, for countries that are only just beginning to develop nuclear energy, such as Bangladesh, Iran, Turkey, Vietnam, and other Middle Eastern and Southeast Asian states.

Improving Nuclear Security Standards as Part of International Cooperation Projects

Russia participates in both of the key international conventions on nuclear security: CPPNM and ICSANT. On July 30, 2008, Russia completed ratification of the amendment to the former convention. That amendment, however, has yet to enter into force.[15] According to Russian officials, the nuclear security arrangements (including physical protection) for nuclear materials, facilities, and storage sites in Russia are at or above the minimum recommended levels stipulated in INFCIRC/225/Rev. 5,[16] an IAEA document released in January 2011.

As Russia pursues international cooperation projects in the peaceful use of nuclear energy, it takes into account the continuous improvement of IAEA standards for physical protection of nuclear materials. After the release of the agency's INFCIRC/225/Rev. 5 (*Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities*), that document became the new standard for agreements on nuclear cooperation newly negotiated by Russia.

For example, the December 12, 2012, agreement on peaceful nuclear energy cooperation with the United Arab Emirates; the February 1, 2013, agreement on nuclear security cooperation with Belarus; and the April 9, 2014, agreement on the removal from Uzbekistan to Russia of spent nuclear fuel of the IIN-3M research reactor contain a provision stipulating that the physical protection measures for nuclear materials and equipment covered by these agreements will meet the minimum requirements of INFCIRC/225/Rev. 5. Meanwhile, the Russian agreement on peaceful nuclear cooperation with Nigeria, as well as a similar agreement with Turkey (both signed in 2009), require physical protection measures at the level stipulated in the previous, INFCIRC/225/Rev. 4 document.[17]

After the release of the IAEA's INFCIRC/225/Rev. 5, that document became the new standard for agreements on nuclear cooperation newly negotiated by Russia.

New standards in physical protection of nuclear materials are also taken into account during the implementation of new projects as part of international agreements signed prior to 2011. One example is the August 25, 1992, agreement with Iran on building a nuclear power plant in Iranian territory (the agreement underpinned the project to build the first unit of the Bushehr NPP). That agreement contained a commitment by Iran "to provide physical protection measures for materials, equipment, and facilities supplied by Russia at or above the level stipulated by IAEA recommendations."[18] The November 11, 2014, protocol to that agreement, which has created the legal framework for Russian-Iranian cooperation in building another two reactors at the Bushehr NPP (and potentially up to eight reactors at two separate sites), specifies that the materials and technologies supplied to Iran "shall be provided with physical protection measures at a level not lower than the levels recommended by the International Atomic Energy Agency document 'Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities' (INFCIRC/225/Rev. 5")."[19]

Eliminating the Nuclear Legacy

According to IAEA data, 118 nuclear research facilities have been built in Russia to date, of which 72 remain in operation.[20] (See Table 1) Some of these facilities are no longer needed and/or don't have the necessary licenses. Many are past their designated life span and must be decommissioned. The average age of the Russian research reactors is 37 years, of critical assemblies is 35 years, and of subcritical assemblies is 42 years. Most of the nuclear research facilities use HEU. About 90 percent of the Russian research reactors use HEU-based fuel.

Spent fuel removal

In the early 1990s, Russia stopped the removal of spent nuclear fuel from nuclear research facilities because of financial constraints. For example, the removal of spent fuel from the Kurchatov Institute was stopped in 1994.[21] The institute, which is in Moscow only about nine miles from the Kremlin, has more nuclear research facilities in operation (19) than any other Russian nuclear research center.[22] According to Rosatom, there are 30,000 irradiated fuel assemblies in temporary storage at the Russian reactor sites. The total amount of spent nuclear fuel produced by the Russian research facilities is over 100 metric tons.[23]

In 2008, the Russian government adopted a federal target program (FTP) called Nuclear and Radiation Safety for 2008 and up to 2015. That program enabled the resumption of spent nuclear fuel removal from the research facilities on a regular basis.[24] The main objective of the program is to comprehensively resolve Russia's nuclear and radiation safety issues related to the management of spent fuel and radioactive waste, the decommissioning of nuclear and radiation hazardous facilities, and the improvement of systems required to ensure and monitor nuclear and radiation safety. A total of 145.33 billion rubles ($5.85 billion) is to be spent on the program.[25] Some 52 percent of that money is to be spent on addressing various nuclear legacy problems.[26]

It must be emphasized that the main objective of the FTP (as reflected in its full name) was to deal with nuclear and radiation safety risks posed by the sites, facilities, and materials that represent the Soviet nuclear legacy. These risks tend to increase over time owing to the degradation of the protective barriers and engineering systems. Additionally, most of the nuclear research facilities are within city limits (with more than 30 such facilities in Moscow alone). In other words, improvements in nuclear security resulting from the reduction of the stockpiles of spent HEU-based fuel have been a useful side effect of measures primarily aimed at improving nuclear and radiation safety.

It is worth emphasizing that the FTP is aimed at addressing urgent nuclear legacy problems, and it prioritizes those facilities where the risk of an emergency or accident is

Table 1. Russian Nuclear Research Facilities: Types and Current State

	Total	Operational	Temporarily shut down	Under construction	Planned
Research reactors	33	29	2	2	1
Critical assemblies	30	29	1	0	0
Subcritical assemblies	9	6	3	0	0
Total	72*	64	6	2	1

* —Total does not include planned reactors

Source: N.V. Arkhangelskiy, I.T. Tretyakov, and V.N. Fedulin, eds., Russian Nuclear Research Facilities *(Moscow: JCS NIKIET, 2012), Table 3.*

especially high. This is why, based on the assessment of risks and the degree of urgency of various projects, the removal of spent nuclear fuel from Russian research facilities is not high on the nuclear and radiation safety program's list of priorities. Nevertheless, the money allocated under the program has resulted in an increase in spent nuclear fuel removal from the research facilities from 0.443 metric tons in 2008 to 31.720 metric tons in 2013.[27] The first in line for spent fuel removal were the Kurchatov Institute, NIIAR, and IPPE, which have the largest fleets of nuclear research facilities and the largest stockpiles of spent fuel.[28]

In 2008–2012, a total of 23.17 metric tons of spent nuclear fuel was removed from Russian nuclear research facilities as part of the program. A further 34.06 metric tons was removed in 2013.[29] As a result of the efforts undertaken in 2008–2013, more than half of the spent nuclear fuel stored at Russia's largest nuclear research centers has been removed. There are no official data on the use of reprocessed nuclear materials, but the Russian nuclear industry has long used uranium extracted from such materials (and downblended, if need be) to make NPP fuel.

The money allocated under the FTP has also been used to upgrade physical protection systems at some nuclear facilities, including the Moscow Engineering Physics Institute (MEPhI), Tomsk Polytechnic University, the Luch Scientific Production Association (NPO Luch) in Podolsk, Moscow Region, and the Mayak Production Association in Ozersk, Chelyabinsk Region.[30]

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The removal of spent nuclear fuel from Russian nuclear research facilities is complicated by the fact that these facilities are supervised by different government agencies. As shown in Table 2, Rosatom controls just over half of these facilities (53 percent).

In principle, the tasks facing Russian specialists as part of this program are similar to those that had to be addressed during the repatriation of fuel under the Russian Research Reactor Fuel Return (RRRFR) program.[31] The experience gained by Russian companies as part of that program can therefore be put to good use in removing spent nuclear fuel from Russia's own nuclear research facilities.

It is expected that by the end of 2015, the Russian government will approve a new federal target program called Nuclear and Radiation Safety for 2016–2020 and up to 2025. That program is referred to as FTP-2. The main objective of FTP-2 will be to implement comprehensive projects at decommissioned facilities

Table 2. Russian Governmental Institutions That Supervise Nuclear Research Facilities

	Total	Research reactors	Critical assemblies	Subcritical assemblies
Rosatom	38 (53%)	21 (64%)	14 (47%)	3 (33%)
Education and Science Ministry	9	3	0	6
Russian Government	24	8	16	0
Ministry of Industry and Trade	1	1	0	0
Total	72	33	30	9

Source: N.V. Arkhangelskiy, I.T. Tretyakov, and V.N. Fedulin, eds., Russian Nuclear Research Facilities *(Moscow: JCS NIKIET, 2012), Table 3.*

that were built as part of the military nuclear program and the nuclear energy program. FTP-2 will make use of the infrastructure created as part of the Nuclear and Radiation Safety for 2008 and up to 2015 (FTP), including the systems and arrangements for spent nuclear fuel management.

There are three scenarios for the implementation of the FTP-2 program, depending on the financing. Under the basic scenario, FTP-2 will be financed to the tune of 486 billion rubles ($9.7 billion), which is more than three times the ruble figure for the first program. As part of that scenario, the objective is to remove and process all spent nuclear fuel from the research facilities by 2025; after that date, temporary storage at the reactor sites will contain only recently unloaded fuel that has not yet reached the end of its cool-down period. Under the basic scenario, all the remaining nuclear legacy problems will have been resolved by 2070.

The rate of the removal of spent fuel from nuclear research facilities depends on several factors:

Russia has shut down nine research reactors that used HEU fuel, with more to follow.

- Many of the spent fuel assemblies that are subject to removal are damaged and leak; special loading and transportation procedures must be developed and used to deal with them.
- There are many types of spent nuclear fuel, and not all of them can be processed at Mayak's RT-1 plant without adjustments to the standard technology (for example, six Russian facilities together—IPPE, MEPhI, NIIAR, the Kurchatov Institute, the Research Institute of Scientific Instruments, and Institute of Reactor Materials—have 40 different types of spent fuel in storage).
- The transport infrastructure at some of the nuclear research facilities has to be upgraded; that includes the restoration of railway tracks to ensure safe loading of spent nuclear fuel.
- The spent nuclear fuel removal operations are costly, while money is tight.

If the economic situation in Russia deteriorates, a conservative scenario for the FTP-2 program will come into effect. The financing will be reduced to 243 billion rubles ($4.9 billion), and the complete resolution of the nuclear legacy problems will be postponed until after 2100. Under the accelerated scenario, with financing ramped up to 774 billion rubles ($15.5 billion), the nuclear legacy will have been dealt with by 2060. In the current situation, the conservative scenario appears very likely, which means the deadlines for removing spent fuel from Russian nuclear research facilities will have to be pushed back.

Decommissioning of nuclear research facilities

Under the basic version of the FTP-2 program, seven nuclear research facilities (including some operated by IPPE) will be decommissioned by 2025.[32] The removal of spent fuel is a necessary preliminary stage before a nuclear research facility can be decommissioned.

Conversion of the currently operational research reactors (including those involved in Mo-99 medical isotopes production) from HEU to low-enriched uranium (LEU) is not part of the existing federal or industry programs. In the short and medium terms, such a conversion appears unlikely. Rosatom believes that the facilities that use HEU have adequate physical protection measures in place in order to prevent any unauthorized access to nuclear material. In addition, it would not make any sense for Russia to use that material for military

purposes because it has plentiful stocks of other material that is more suitable for making nuclear weapons. At the same time, it is possible that some companies will switch their isotopes production from HEU to LEU targets using their own financing and money provided by the government as part of relevant research-and-development programs and programs supporting innovation in nonenergy nuclear applications.

Russia has shut down nine research reactors that used HEU fuel, with more to follow. The decommissioning of these reactors is expected to be financed from the federal budget. The part of the FTP-2 program released to the public domain does not specify which reactors will be decommissioned by 2025. Russia lacks an integrated concept of decommissioning research reactors that would detail plans beyond 2025.

Even before the adoption of the FTP program, the Kurchatov Institute began to take steps to eliminate the nuclear legacy and decommission several nuclear research facilities. As part of that program, work is currently under way to decommission the institute's largest reactor, a 50-megawatt MR research reactor, and its predecessor, the RFT reactor. A total of 900 million rubles was spent on that project in 2008–2012 (more than $30 million at the exchange rate of December 31, 2008).

The conversion of the Argus reactor at the Kurchatov Institute in May 2014 was the first conversion of a research reactor from HEU to LEU in Russia.

At the initiative of the United States, in 2010, Rosatom and the US Department of Energy (DOE) signed the Implementing Agreement Regarding Cooperation in Conducting Feasibility Studies of the Conversion of Russian Research Reactors. Under the terms of the agreement, Rosatom and the DOE study the technical and economic feasibility of converting six Russian reactors: Argus, OR, and IR-8 at the Kurchatov Institute; IRT-MEPhI at MEPhI; MIR.M1 at NIIAR; and IRT at Tomsk Polytechnic University.

The first reactor to have been converted under that program was Argus at the Kurchatov Institute. The Argus conversion project was largely completed in 2014. Conversion of the other reactors is being held back by the lack of reliable and properly certified high-density LEU-based fuel. In some cases there are also economic considerations, since reactor conversion and the use of new fuel would substantially increase operational costs.

Consolidation and conversion program

Fresh nuclear materials do not fall under the scope of the nuclear and radiation safety program of FTP and FTP-2. But over the decades, the Soviet Union's nuclear industry had produced large amounts of nuclear materials, including HEU. A large part of these materials was held by companies and research facilities in Russia. Many of these fresh (nonirradiated) materials are no longer needed for research or experiments. Meanwhile, any company or organization that has highly enriched uranium on its books has to bear additional costs to provide adequate security arrangements and accounting for it.

According to specialists of NPO Luch, which is one of the main Russian companies implementing the consolidation and conversion program, in the 1990s more than 50 sites in Russia held approximately 10 metric tons of uranium-containing materials that were no longer needed and were suitable for processing as part of the consolidation and conversion program.[33]

The Russian HEU consolidation and conversion program has been running since 1999. According to the Russian memorandum at the 2012 Nuclear Security Summit, a total of 1,320 kilograms of HEU (by U-235 content) that was surplus

to requirement was converted in 2010–2011.[34] As of 2012, approximately 8 metric tons of surplus nuclear materials (by U-235 content) had been consolidated and converted.[35] In 2013, the design bureau OKBM Afrikantov produced an expert conclusion on the availability of surplus material; it was decided to transfer that material to NPO Luch as part of the consolidation and conversion program.[36] According to some estimates, a total of about 10 metric tons of HEU-based surplus material had been converted by 2014.[37]

It was originally expected to take 15 years to complete the work under the consolidation and conversion program,[38] but it appears that the amount of material that falls under its scope exceeds the estimates made by Luch specialists about ten years ago.[39] This means that the consolidation and conversion efforts will continue. Up until recently, technical assistance provided by the DOE was the main source of the program's funding, and the main mechanism of coordination of Russian-US cooperation was the Nuclear Energy and Nuclear Security Working Group (known as the Kiriyenko-Poneman group), established under the US-Russia Bilateral Presidential Commission. In March 2014, the United States suspended the work of that group as a result of the crisis in Ukraine.

By March 2015, the RRRFR program had removed a total of about 800 kilograms of fresh HEU fuel and about 1,350 kilograms of irradiated HEU fuel, for a total of 2,146 kilograms, in more than 60 operations.

Global Priorities

As already mentioned, the Russian approach to nuclear security is based on the notion that the global nuclear security regime can be effective only if every country has an effective and adequate nuclear security system at the national level. That is why Russia has been prepared to help other countries—especially those that are just beginning to develop nuclear energy and lack relevant expertise—build individual elements of their nuclear security infrastructure.

In 2010, Russia began to make annual voluntary contributions to the IAEA Nuclear Security Fund (it paid $6.5 million in 2010–2015). Much of that money is being used to provide nuclear security training to personnel from third countries. Russian interagency efforts are now being made to make sure that Moscow continues to provide financing for the Nuclear Security Fund.

As part of the Russian contribution to implementing the decisions of the 2012 Nuclear Security Summit in Seoul and the 2014 summit in The Hague, Rosatom has held three workshops on nuclear security culture for specialists involved in building, operating, and planning the construction of NPPs based on Russian reactor technology. The events were held with the support of the Russian Foreign Ministry and in cooperation with the IAEA. The latest course, attended by nearly 50 experts from eight countries, was delivered in early December 2014 at the Rosatom Central Institute of Continuous Education and Training.[40] International summer schools on security culture are held annually in cooperation with the IAEA.

Russia also provides assistance in this area to IAEA members that are planning to develop peaceful nuclear energy or have already launched peaceful nuclear energy programs. Russia holds regular IAEA training courses on physical protection at its special training center in Obninsk. More than 500 foreign specialists in material protection, control, and accounting have been trained since 2001.[41]

Russia is also actively involved in dealing with the nuclear legacy problems in other countries where the nuclear research infrastructure was built with Soviet assistance and is based on Russian technologies.

As part of the RRRFR program of sending to Russia the fuel of Soviet-built research reactors (which is a joint endeavor with the United States and the IAEA), Russia repatriates fresh and spent HEU-based fuel. The reactors are subsequently converted to use LEU fuel if the host country wants to keep them in operation. As of March 1, 2015, all fresh and spent HEU fuel has been removed from nine of the 14 participating countries (Bulgaria, the Czech Republic, Hungary, Latvia, Libya, Romania, Serbia, Ukraine, and Vietnam). Only Belarus still has some fresh HEU-based fuel that is yet to be removed. Some HEU-based spent fuel is also left in Germany, Kazakhstan, Poland, and Uzbekistan. The removal of fuel from Uzbekistan is expected to be completed sometime in 2015; from Poland, in 2016. In Kazakhstan, the last batch of HEU-based spent fuel is to be removed no later than 2020.[42]

By March 2015, the RRRFR program had removed a total of about 800 kilograms of fresh HEU fuel and about 1,350 kilograms of irradiated HEU fuel, for a total of 2,146 kilograms, in more than 60 operations. A total of about 2,700 kilograms of nuclear fuel is to be removed under the RRRFR program by 2020. The most recent removal took place in December 2014, when about 36 kilograms of spent HEU fuel was transferred to Russia from Kazakhstan in two shipments.[43]

Opportunities for Russian-US Cooperation

The crisis over Ukraine has dealt a heavy blow to Russian-US nuclear cooperation. The United States has shut down or frozen several channels for dialogue and cooperation, including the G-8, the Working Group on Nuclear Energy and Nuclear Security under the bilateral Russian-US Presidential Commission, and the R&D Agreement (which was signed in 2013 and entered into force in 2014). The expectation was that the R&D Agreement would stimulate cooperation between Russian and US national laboratories and research centers. The agreement outlines potential areas of cooperation, including civilian nuclear energy, designing NPPs and developing new types of nuclear fuel, nuclear science, the use of nuclear and radiation technologies in health care and industry, nuclear waste management, nonproliferation, and nuclear safety and security. The document also regulates access to research facilities in accordance with the agreed procedures.[44]

Russia often implements projects under the "nuclear and radiation safety" umbrella that would be viewed in the United States as part of the nuclear security effort.

In October 2014, Russia decided not to take part in preparations for the 2016 Nuclear Security Summit, which will be in the United States. Russia has emphasized, however, that the decision on whether it will take part in the actual summit has yet to be made. On November 5, 2014, the Russian Foreign Ministry issued a statement in which it said that one of the reasons for its stance was the US-proposed approach to the preparations whereby special privileges are given to the United States, South Korea, and the Netherlands (the hosts of the previous summits) at the expense of other participants. (It was proposed, for example, that all countries other than these three could participate in only one of the five working groups.) Also, in Russia's opinion, most of the commitments undertaken by the participants at the previous summits have been fulfilled, so the political agenda for any new summits has been all but exhausted.[45]

In the meantime, Russia and the United States continue their consultations on issues that will be the focus of the upcoming summit. Speaking at the Moscow Nonproliferation Conference in November 2014, Russian Deputy Foreign Minister Sergey Ryabkov said Russia was not indifferent to what was going on as part of the preparations for the summit and to the decisions being made. He expressed his hope that the United States would keep Russia informed about these preparations.[46] The US sherpa for the summit, Laura Holgate, said at the Carnegie Nuclear Policy Conference in March 2015 that 53 countries were taking part in the nuclear security summits cycle (a number that includes Russia).

In the current political situation, the prospects for closer Russian-US nuclear cooperation, including efforts to strengthen the nuclear security regime, will largely depend on two factors. The first is the two countries' ability to incorporate such cooperation in the shifting framework of their bilateral relations. The second is their ability to overcome the differences in their priorities. Russia places a heavy emphasis on innovation and new technologies in nuclear energy and nonenergy applications, with simultaneous efforts to deal with the problems of nuclear legacy. For the United States, the utmost priority is nuclear security. A way will have to be found to reconcile these different interests.

There are four main nuclear-related areas in which Washington is willing to pursue dialogue with Moscow: the Iranian nuclear file, nuclear security, the New START treaty, and the INF Treaty. However, discussions in these four areas clearly aren't enough to overcome the aforementioned differences in priorities.

Russia has a different perception of the urgency of nuclear security threats and a different classification of the relevant projects. It often implements projects under the "nuclear and radiation safety" umbrella that would be viewed in the United States as part of the nuclear security effort. This has been amply demonstrated by the nature of the Russian federal target program on nuclear and radiation safety, in which projects to remove and reprocess spent HEU-based research reactor fuel and the decommissioning of research reactors that use HEU are viewed in the nuclear safety context. Closer cooperation in this area will require a broader package that would include the Russian priorities, emulating perhaps the later phase of the Kiriyenko-Poneman working group, whose agenda included nuclear security as well as cooperation in civilian nuclear energy.

Rosatom and the DOE could take practical steps to stimulate the development of commercial mechanisms for financing and implementing projects that help strengthen nuclear security.

It is clear that the model of nuclear security cooperation that relied primarily on the United States' providing technical assistance or financing in exchange for access to Russian nuclear facilities is now a thing of the past.

If Moscow and Washington manage to overcome the structural obstacles to bilateral cooperation, they could work together in several areas directly relevant to nuclear security. In order to develop and agree on specific cooperation projects, they could use the existing coordination mechanisms in the area of nuclear cooperation set up in accordance with various bilateral agreements, including the 123 Agreement, the R&D Agreement, the MNEPR and Russian-US related Protocol, and the Agreement Concerning Cooperation for the Transfer of Russian-Produced Research Reactor Nuclear Fuel to the Russian Federation.

For example, under the basic version of the FTP-2 program, about 6 percent of the funding is to be spent on research and development that is required to achieve the program's goals; that includes the removal of spent nuclear fuel from nuclear research facilities and decommissioning these facilities. The program also hopes to attract extrabudgetary financing (which could account for up to 14 percent of the program's cost). Rosatom and the DOE could explore the possibility of joint research-and-development projects, financed 50-50 and based on the win-win approach. They would help Russia to achieve the objectives set out in the FTP-2 program while also contributing to the US priority of strengthening nuclear security. One specific area of continued cooperation is the development and certification of new high-density LEU fuel that is required for the conversion of reactors from HEU to LEU in Russia and in the United States.

Rosatom and the DOE could also take practical steps to stimulate the development of commercial mechanisms for financing and implementing projects that help strengthen nuclear security. Given the size of the US market for medical

isotopes and Russia's potential production capacity, the two countries could work together to create commercial incentives for the transition of Russian Mo-99 production to the use of LEU targets (at the first stage) and eventually LEU fuel. Another important result of such cooperation would be greater stability of supply to the global and US markets of Mo-99 isotopes, which are widely used in the diagnostics of cancer and heart disease. The United States could adopt a pragmatic approach, just as it did in the case of implementation of the HEU Purchase Agreement, when a growth in the Russian nuclear industry's revenues was seen as serving US national security interests.[47]

Also, given the current political situation, some individual areas of nuclear cooperation can be seen as promising if the necessary international legal framework has already been put in place. In this context, Rosatom and the DOE should take additional measures to implement the intergovernmental Plutonium Management and Disposition Agreement, under which each side is to dispose of 34 metric tons of plutonium, removed from nuclear weapons programs. It is well known that disposing of nuclear materials, especially those suitable for building weapons, is one of the most effective ways to strengthen nuclear security.

Yet another important area of cooperation is exchanging best practices related to various aspects of nuclear security, such as use of the latest security technologies, improving security culture among nuclear personnel, and eliminating the nuclear legacy (including consolidation of nuclear materials, spent nuclear fuel management, and decommissioning of nuclear research facilities).

The priority areas of cooperation in third countries include the completion of measures to eliminate the nuclear legacy (i.e., removing the last remaining batches of HEU) and potentially using the RRRFR experience in the removal of spent research reactor fuel enriched to less than 20 percent of U-235 content. Other priorities include cooperation in equipping the border crossings with radiation monitors in countries that have a common border with Russia (especially the former Soviet states) as part of the Second Line of Defense Program, where Moscow and Washington already have a lot of cooperation experience. Lack of cooperation or coordination in this area could lead to the emergence of a potential for conflict in Russian-US relations because it directly impinges on Russian security interests.

Continued effective nuclear security cooperation will be possible only if Russia and the United States are willing to adopt a pragmatic approach to joint efforts.

Conclusion

Russia and the United States bear special responsibility for keeping nuclear materials safe and secure, preventing them from falling into the hands of terrorists, and maintaining reliable physical protection measures. Russian and American nuclear security priorities, both domestic and global, create natural opportunities for cooperation between the two countries in this area. But for this to happen, a new model of cooperation will have to be devised, based on equality and on properly taking into account each other's priorities, which do not always coincide.

Governmental experts will also have to overcome their inertia; some of them still hope that cooperation will continue on the same basis that was laid down 10 or 15 years ago. Such an approach not only hampers the establishment of new contacts on nuclear security issues but also serves to reduce the existing ones. Continued effective nuclear security cooperation will be possible only if the two countries are willing to adopt a pragmatic approach to joint efforts in this area and insulate contacts from the general negative background and trends in their bilateral relations.

Endnotes

[1] The views expressed here are solely those of the author in his private capacity and do not necessarily represent the views of his organization.

[2] In recent years, that figure stood at about 16 percent. See Draft Russian Energy Strategy to 2035, p. 82, accessed March 7, 2015, *http://minenergo.gov.ru/upload/iblock/621/621d81f0fb5a11919f912bfafb3248d6.pdf.* These targets, however, can be revised downward in view of the Russian economic slowdown.

[3] Komarov Kirill, "Orders on Hand," *Vestnik Atompropma*, Vol. 4, No. 4, 2014, p. 9.

[4] "Rosatom Portfolio of Foreign Contracts for the Next Decade Now Worth over 100bn Dollars," *Interfax*, December 11, 2014, accessed March 7, 2015, *http://www.interfax.ru/business/412390.*

[5] Rosatom 2013 annual report, p. 8, accessed March 10, 2015, *http://www.ar2013.rosatom.ru/51?asd=150.*

[6] Russia downblended 500 metric tons of HEU under the HEU Purchase Agreement; this is more than twice the amount downblended over the same period by all other countries put together. For more details on the program, see Mikhail Aboimov, Anton Khlopkov, and Thomas Neff, "Megatons to Megawatts Program: Hard Lessons and New Opportunities for US-Russian Nuclear Cooperation," *Russia Direct Quarterly Report*, March 2014, p. 32.

[7] Rosatom security report, 2014, p. 21, accessed March 10, 2015, *http://www.rosatom.ru/resources/2912b48045994631a98ce93e3990b085/ot4et_bezopas_2013_24+09+2014.pdf.*

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[9] Russian Cabinet Resolution No. 456, of July 19, 2007, *On Approving the Guidelines for Physical Protection of Nuclear Materials, Nuclear Facilities, and Nuclear Material Storage Sites*, accessed March 7, 2015, *http://www.rg.ru/2007/07/31/yadzaschita-site-dok.html.*

[10] Changes to the guidelines were made by Cabinet resolutions of April 22, 2009; September 8, 2010; February 4 and May 16, 2011; August 28, 2012; February 16, 2013; and February 18 and March 14, 2014.

[11] Order No. 169, of March 18, 2009, by the Federal Service for Environmental, Technological, and Nuclear Supervision, *On Approving and Enacting the Procedure of Assessment of the Level of Security Culture at Nuclear Fuel Cycle Facilities (RB-047-08)*, accessed March 7, 2015, *http://arch.gosnadzor.ru/osnovnaya_deyatelnost_slujby/gosudarstvenniy-nadzor-za-yadernoy-i-radiatsionnoy-bezopasnostyu/normativnie-dokumenti/prikaz-federalnoy-sluzhbi-po-ekologicheskomu-tehnologicheskomu-i-atomnomu-nadzoru-ot-18-marta-2009-g-169-ob-utverzhdenii-i-vvedenii-v-deystvie-rukovod/.*

[12] Order No. 255, of April 17, 2012, by the Federal Environmental, Industrial and Nuclear Supervision Service "*On Approving Federal Norms and Regulations in the Area of Nuclear Energy Use "Main Guidelines for Nuclear Material Accounting and Control,*" accessed March 7, 2015, *http://www.rg.ru/2012/10/30/atom-uchet-site-dok.html.*

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[14] Order No. 89, of March 4, 2014, by the Federal Environmental, Industrial and Nuclear Supervision Service *On Approving the Standard Program of Targeted Inspections of Physical Protection Arrangements for Nuclear Materials, Nuclear Facilities, and Nuclear Material Storage Sites*, accessed March 7, 2015, *http://www.garant.ru/products/ipo/prime/doc/70503892/#ixzz3Th0VLnSY.*

[15] The CPPNM amendment will not go into effect until it is ratified by two-thirds of CPPNM members, who now total 102 states. As of January 2015, 83 states had ratified the amendment. For an update, see the IAEA website, *https://www.iaea.org/Publications/Documents/Conventions/cppnm_amend_status.pdf*, accessed March 8, 2015.

[16] Berdennikov, "Implementing Practical Nuclear Security Measures," p. 12.

[17] Russian-Turkish intergovernmental agreement on peaceful nuclear energy cooperation, Ankara, August 6, 2008, accessed March 10, 2015, *http://www.mid.ru/bdomp/spd_md.nsf/0/E488FE815A073C9443257E0000219D11*; Russian-Nigerian intergovernmental agreement on peaceful nuclear energy cooperation, Abuja, June 26, 2009, accessed March 10, 2015, *http://www.mid.ru/bdomp/spd_md.nsf/0/99961E4097CA820B43257E0000219D94.*

[18] Russian-Iranian agreement on cooperation in building a nuclear power plant in Iran, August 25, 1992, translated from Russian, accessed March 7, 2015, *http://www.mid.ru/bdomp/spd_md.nsf/0/BEFE36638A65DC1B43257E000021BA79.*

[19] Protocol to the Russian-Iranian agreement on cooperation in building a nuclear power plant in Iran of August 25, 1992, signed November 11, 2014, accessed March 7, 2015, *http://www.rosatom.ru/en/resources/adf43c00462aa4d7b6e4f6d490c073ed/protocol_russia_iran_eng.pdf.*

[20] IAEA Research Reactor Database, accessed March 8, 2015, *http://nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx?rf=1*; N.V. Arkhangelskiy, I.T. Tretyakov, and V.N. Fedulin, eds., *Russian Nuclear Research Facilities* (Moscow: JCS NIKIET, 2012), Tables 3, 4.

[21] Another nuclear research facility at the Kurchatov Institute is temporarily shut down.

[22] In 1943, the site of the future Kurchatov Institute was a 120-hectare potato field between the villages of Khoroshevo and Shchukino.

[23] A.A. Abramov, deputy director for state policy on radioactive waste, spent nuclear fuel, and decommissioning of nuclear and radiation hazardous facilities, "Outcome of the Implementation of the Federal Target Program Nuclear and Radiation Safety for 2008 and up to 2015," Slide 16, meeting of the Rosatom corporation's Public Council, April 12, 2013.

[24] Some organizations, including the Kurchatov Institute and the Institute of Reactor Materials in Zarechnyy, Sverdlovsk Region, began spent nuclear fuel removal using their own sources of funding.

[25] The figure in US dollars is based on the average exchange rate in 2008, when the program was approved. The exchange rate was 24.8553 rubles to the dollar at the time.

[26] Abramov, "Outcome of the Implementation," Slides 2 and 5.

[27] In 2008, most of the reprocessed fuel was material removed under the RRRFR program from nuclear research reactors in other countries. *2008 Nuclear Safety Report* (Moscow: Komtekhprint, 2009), pp. 29, 49.

[28] Federal Target Program Nuclear and Radiation Safety for 2008 and up to 2015: Results in 2008-2012 (Moscow: Rosatom State Corporation, 2013), p. 14, accessed March 11, 2015, *http://www.fcp-radbez.ru/images/stories/FCP/materiali/booklet_fcp_2008-2015.pdf*.

[29] Rosatom security report, 2014, p. 42, accessed March 10, 2015, *http://www.rosatom.ru/resources/2912b48045994631a98ce93e3990b085/ot4et_bezopas_2013_24+09+2014.pdf*; Abramov, "Outcome of the Implementation," Slide 16.

[30] A.A. Abramov, deputy director for state policy on radioactive waste, spent nuclear fuel, and decommissioning of nuclear and radiation hazardous facilities, "Concept of the Federal Target Program Nuclear and Radiation Safety for 2016–2020 and up to 2015," Slide 3, meeting of the Rosatom corporation's Public Council, June 17, 2014, accessed March 11, 2015, *http://www.slideshare.net/connecticalab/ss-36191345*.

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[35] *G-8 Global Partnership: Assessment and Prospects of Further Cooperation on Nuclear and Radiation Security, Moscow Conference*, November 21–23, 2012, accessed March 7, 2015, *http://www.atomic-energy.ru/documents/37385*.

[36] Atomenergomash 2013 annual report, p. 76, accessed March 10, 2015, *http://ar2013.aem-group.ru/*.

[37] *Past and Current Civilian HEU Reduction Efforts*, Nuclear Threat Initiative, accessed March 10, 2015. *http://www.nti.org/analysis/articles/past-and-current-civilian-heu-reduction-efforts/ 150*.

[38] Evplanov, "Assessing the Economic Effectiveness," p. 16.

[39] Information about the size of the Russian stockpiles of nuclear materials is classified. That is why there is no reliable information about the amount of HEU-based materials that potentially fall under the scope of the consolidation and conversion program.

[40] "International Seminar on Nuclear Security Culture Kicks Off in Moscow," Atomic-Energy.ru, December 3, 2014, accessed April 20, 2015, *http://www.atomic-energy.ru/news/2014/12/03/53465*.

[41] Statement by the head of the Russian delegation, head of the Department for Nonproliferation and Arms Control at the Russian Foreign Ministry, M.I. Ulyanov, on Block II (Nonproliferation and IAEA Safeguards) at the Second Session of the Preparatory Committee of the 2015 NPT Review Conference, New York, April 26, 2013, accessed March 10, 2015, *http://www.mid.ru/bdomp/ns-dvbr.nsf/10aa6ac6e80702fc432569ea003612f0/44257b100055dde344257b5c004dac01!OpenDocument*.

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[43] "US, Kazakhstan Cooperate to Eliminate Highly Enriched Uranium," National Nuclear Security Administration, January 7, 2015, accessed March 10, 2015, http://nnsa.energy.gov/mediaroom/pressreleases/kazakhstan.

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