The Future of Russia: The Nuclear Factor

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ABSTRACT

Two factors were of critical significance in shaping the international peace and security agenda after the Cold War: the emergence of nuclear security and proliferation dangers in the wake of the Soviet collapse, and the unprecedented level of cooperation between Russia and other countries to address these problems. As a result of cooperative international and Russia's domestic efforts, important progress has been made in recent years in reducing nuclear arsenals, protecting Russia's nuclear materials, and preventing proliferation of nuclear weapons expertise from Russia. Much work, however, remains to be done.

There are presently no definite answers about the future of the nuclear security agenda in Russia. The Russian nuclear legacy – its nuclear forces, the nuclear-weapons production and power-generation complex, huge stocks of nuclear-useable highly-enriched uranium and plutonium, and environmental clean-up problems – is not going to go away anytime soon. What is clear is that nuclear security and proliferation risks will be high as long as there remain their underlying causes: the oversized and underfunded nuclear complex, the economic turmoil, and wide-spread crime and corruption. The magnitude of the problem, however, could vary significantly depending on Russia's progress in downsizing of its nuclear weapons complex; its ability to maintain core competence in the nuclear field; availability of funding for the nuclear industry and safeguards and security programs; political commitment by the Russian government to improve nuclear security; and international cooperation. Economically-prosperous Russia, the rule of law, and a smaller, safer and more secure nuclear complex would make nuclear risks manageable. An integration of the Russian nuclear complex into the world's nuclear industry, increased transparency of nuclear operations, and cooperative nuclear security relations with the United States and other western countries are also essential to reducing nuclear dangers and preventing catastrophic terrorism.

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Introduction

The nuclear arms race and the possibility of an all-out nuclear war between the Soviet Union and the United States were the dominant international security factors during the Cold War. While Russia remains world's only power that can destroy the U.S. society, the collapse of communism in the late 1980s and the breakup of the Soviet Union in 1991 ended the Cold War and made a deliberate U.S.-Russian nuclear exchange unthinkable. The disintegration of the Soviet empire and the difficult economic and societal transition in its successor states have fueled major concerns about safety and security of post-Soviet nuclear weapons, and possible leakage of nuclear-materials, weapons-related technologies, and expertise to proliferating states or terrorist groups. To address these problems, the Russian government and the international community have launched a range of unprecedented cooperative nuclear security programs. The

September 11, 2001 terrorist attack came as a dramatic reminder of the urgency and significance of these efforts. The attack made it clear that the threat of a large, organized, and international in its reach terrorist network mounting a catastrophic attack against the western society is very real. It also demonstrated that if terrorists were to acquire nuclear explosives they would not hesitate using them to maximize civilian casualties and societal disruption.

The events of September 11 also created a new opportunity to redefine and improve U.S.-Russian strategic relations, which had been in steady decline since the mid-1990s. Russia's support of the U.S. war against terrorism in Afghanistan and new arms reduction initiatives are good signs. The Bush administration in the United States has reconfirmed its commitment to nonproliferation assistance programs in Russia. The hope now is that the two countries would expand nonproliferation and nuclear security cooperation and make it a centerpiece of this new, emerging relationship.

The future of Russia's nuclear factor is, in many ways, an open question. It is clear that the Russian nuclear legacy – its nuclear weapons, the nuclear-weapons production and power-generation complex, huge stocks of nuclear-useable highly-enriched uranium (HEU) and plutonium, and environmental clean-up problems – is not going to disappear anytime soon.[1] The extent of the companion nuclear safety and security risks for Russia and the international community, however, could vary dramatically depending on economic and political directions of Russia and its relations with the rest of the world.

This essay seeks to explore possible future directions and significance of Russia's nuclear security agenda. The essay begins with a brief overview of the Russian nuclear program. It then discusses nuclear security and nonproliferation concerns after the Cold War as well as the efforts by Russia and the international community to address these problems. Finally, it analyzes key factors that are likely to influence the nuclear security agenda in Russia during the next ten or so years.

Russia's Nuclear Legacy

After the disintegration of the Soviet Union in 1991, Russia inherited much of the Soviet nuclear infrastructure. Today, the Russian complex consists of inter-linked defense and civilian components, two of which – the nuclear research and production complex and the nuclear forces – are discussed below in greater detail.

Research and Production Nuclear Complex

The Soviet Union started a crash program to build nuclear weapons in 1945. Four years later, on August 29, 1949, it successfully tested its first nuclear explosive device.

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[1] According to the International Atomic Energy Agency (IAEA) standards, HEU is defined as uranium enriched in the isotope uranium-235 to more than 20%. Higher levels of enrichment are required to use HEU for fabrication of a practical nuclear explosive device. The critical mass (the bare mass of uncompressed material required to initiate a neutron chain reaction) of 50-% enriched uranium is a factor of three greater than that of 93.5-% uranium. Plutonium of any isotopic composition (with the exception of plutonium-238) can be used in nuclear explosives. However, weapon designers prefer to use plutonium with high levels of plutonium-239. Plutonium containing more than 94% of plutonium-239 is termed weapon-grade. According to the IAEA, 25 kg of uranium-235 (as HEU) or 8 kg of plutonium is required to produce a single nuclear explosive device. Efficient designs and improved manufacturing technologies could considerably reduce fissile material requirements.

In parallel, the Soviet Union launched an effort to establish a massive industry to produce highly-enriched uranium and plutonium for weapons, and design, test, and mass produce nuclear bombs and warheads.

In the 1950s and 1960s, Soviet nuclear scientists and engineers initiated work in the areas of fundamental and applied nuclear science, naval propulsion, and nuclear power generation. These programs were supported by further expansion and diversification of the nuclear complex and were often integrated with nuclear weapons activities. By the mid- to late 1980s, the Soviet Union had a vast and diverse nuclear complex. At its peak, the complex (much of which is currently managed by the Ministry of Atomic Energy or Minatom) consisted of approximately 150 research institutes and production facilities and employed approximately one million people.

The end of the Cold War and the breakup of the Soviet Union have brought about a dramatic change in the nuclear area. Many elements of the weapons development and production program were scaled back or halted. The nuclear power program was frozen for almost 15 years in the aftermath of the 1986 Chernobyl disaster. Funding for nuclear projects was reduced. The nuclear industry, similar to other defense industries in Russia, went into a downward spiral. The decline continued until the late 1990s, when the complex started showing tentative signs of recovery.

The Minatom complex can be described as consisting of the two parts: the nuclear weapons production complex and the civilian sector.

The nuclear weapons production complex is currently comprised of 17 facilities that were built to develop, test, produce, and support field-deployment of nuclear weapons.[2] Approximately 75,000 workers are directly involved in nuclear weapons-related work. The complex is significantly smaller compared to its Cold War size and further reductions are expected in the next five to ten years (see below).

The core elements of the nuclear weapons program are located in closed nuclear cities. Ten closed cities were built originally to produce and process fissile materials for the weapons program; and to design and mass-produce nuclear weapons.[3] The existence of the cities was not officially acknowledged until 1992 and their present status is that of "closed administrative-territorial units." The cities are surrounded by double fences that are patrolled by armed guards. Access is limited and thoroughly controlled. The main purpose of stringent security arrangements is to prevent a terrorist attack against and to protect secrecy of sensitive nuclear operations. The cities currently have a combined population of approximately 760,000 people, of whom 130,000 work at nuclear facilities.

The Minatom's civilian sector includes tens of institutes and production facilities that are involved in a full range of nuclear technology activities: basic and applied science and technology development, construction and operation of nuclear reactors, fuel cycle operations, and construction and other supporting operations. Many civilian facilities process or store significant quantities of nuclear materials.

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[2] Minatom's Deputy Minister L.Ryabev, remarks at an international conference "Helping Russia Downsize its Nuclear Weapons Complex," Princeton, March 2000.

[3] The production of HEU and plutonium took place in five cities (new names in parentheses): Chelyabinsk-65 (Ozersk), Tomsk-7 (Seversk), Krasnoyarsk-26 (Zheleznogorsk), Sverdlovsk-44 (Novouralsk), and Krasnoyarsk-45 (Zelenogorsk). Arzamas-16 (Sarov) and Chelyabinsk-70 (Snezhinsk) were established as nuclear weapon design centers. And serial production of nuclear warheads took place in Arzamas-16 (Sarov), Sverdlovsk-45 (Lesnoy), Zlatoust-36 (Trekhgorny), and Penza-19 (Zarechny).

Since the beginning of the atomic program, the Soviet Union accumulated world's largest stocks of weapon-usable materials: an estimated 1200 t HEU and 150 t plutonium.[4] A large fraction of these inventories is associated with intact nuclear weapons and is controlled by the Ministry of Defense. Much of the remainder (an estimated 960 t of HEU and plutonium) is stored, processed, or used at Minatom's facilities.

After the Cold War, Minatom's complex (primarily facilities in closed nuclear cities) has become involved in storage and disposition of excess fissile materials recovered from retired warheads. Under the 1993 HEU agreement, the United States agreed to buy at least 500 t of Russian HEU from dismantled weapons for use in power reactors. This HEU is downblended in Russia to fuel-grade low-enriched uranium prior to delivery to the United States. The United States implements a set of transparency measures to verify that downblended uranium is of HEU origin. As of January 1, 2002, 141 t HEU was converted to low-enriched uranium and delivered to the United States.[5]

The United States and Russia each declared 34 t plutonium to be an excess to military requirements. The two countries, in cooperation with France, Germany, and other industrialized countries are working to establish an infrastructure in Russia to fabricate plutonium into Mixed-Oxide (MOX) fuel of power reactors.[6] The progress so far has been slow because of high cost of the program (an estimated $2 billion). It is likely that plutonium will remain in storage for many years.

Nuclear Forces

Following the successful test of the first nuclear device in August 1949, the main Soviet priority was to expand and increase the diversity of the nuclear stockpile and to make it available to war-fighters. During the 1950s and 1960s, the Soviet military worked to integrate nuclear weapons into strategic and tactical war plans and to develop an infrastructure for their field deployment.

By the mid-1980s, the Soviet stockpile reached an estimated level of 35,000 strategic and tactical nuclear weapons. The Soviet strategic nuclear forces included nuclear powered strategic submarines with intercontinental ballistic missiles (SLBMs), land based intercontinental missiles (ICBMs), and long-range bombers. A large fraction of the arsenal consisted of tactical weapons (artillery shells, bombs, warheads for ballistic missiles, etc.) intended for battle-field use and deployed throughout the Soviet Union as well as on the territory of its East European allies. Thousands of nuclear warheads were also produced to arm air-defense and anti-ballistic missile missiles. Tens of thousands of military personnel were trained to perform nuclear related missions.

As a result of the Intermediate Nuclear Forces (INF) and START I treaties, the Bush-Gorbachev unilateral tactical weapons initiatives of 1991 that called for consolidation and, for certain classes, elimination of tactical weapons, decommissioning of aging delivery systems, and the retirement of unsafe and obsolete warheads, the

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[4] D. Albright, F. Berkhout and W. Walker, *Plutonium and Highly Enriched Uranium 1996*, SIPRI (Oxford: Oxford University Press, 1997).

[5] US-RUSSIAN MEGATONS TO MEGAWATTS PROGRAM: FACTSHEET, United States Enrichment Corporation, January 1, 2002 (http://www.usec.com/v2001_02/HTML/megatons_fact.asp).

[6] *Office of Fissile Material Disposition: Strategic Plan*, DOE/NNSA, June 2000.

Russian stockpile is estimated to have declined to approximately 10,000 operational and reserve warheads in 2000.[7] During the October 2001 summit in Washington and at the Crawford Ranch in Texas, and Russian presidents pledged that in the next ten years the two countries would each reduce their strategic weapons to 1,700-2,200 warheads. Even without joint U.S.-Russian arms reduction initiatives the stockpile is projected to decline to approximately 5,000 warheads by 2005-2010 as a result of retirement of strategic delivery systems and their platforms (such as ICBMs, bombers, and submarines) and in the absence of mass-production of new tactical weapons.

Nuclear Security in Russia After the Cold War

A critical question during the immediate aftermath of the Soviet break up in 1991 was which of the newly independent states were going to inherit the Soviet nuclear arsenal. As discussed below, this issue was settled successfully and quite rapidly, if not without drama. In contrast, the problems of nuclear safety and security have persisted and remain a major risk to international security.

Nuclear Successor States

The breakup of the Soviet Union in 1991 left four countries with strategic nuclear weapons: Russia, Kazakhstan, Ukraine, and Belarus. (In contrast, all core nuclear weapons production facilities remained in Russia.) Removal of thousands of nuclear weapons from the non-Russian republics to Russia for dismantlement became an urgent priority for the international community. Signals from Ukraine were particularly worrisome. Some of its politicians were openly questioning the wisdom of sending nuclear weapons to Russia. Shipments of nuclear weapons were delayed. And Russian technical experts were refused access to nuclear weapons storage facilities in Ukraine. The United States and Russia eventually convinced Ukraine to give up its weapons in exchange for payments (in the form of fresh nuclear reactor fuel) for HEU from weapons removed from its soil. The last train with nuclear weapons left Ukraine in May 1996. Belarus and Kazakhstan followed the suit and, eventually, all three countries signed the Nonproliferation Treaty (NPT) as non-nuclear weapons states.

The diminishing control of Moscow over Russia's provinces during the Yeltsin administration raised the concern about "nuclear regionalism." Some analysts believed that the Russian Federation could split further into smaller pieces and that the centralized control of nuclear weapons could be jeopardized as a result. Another scenario involved a collusion of regional elites with local criminal organizations to assert control of nuclear weapons facilities in their regions and to use them to blackmail the Russian federal government or the international community. Putin's steps to strengthen the role of the federal government in Russia's provinces have generally alleviated these concerns.

Accidental or Unauthorized Nuclear Launch

While the probability of an intentional nuclear war between the United States and Russia has declined dramatically, the two countries continue to maintain a significant fraction of their nuclear forces on a hair-trigger alert, ready for launch on a several-

[7] "NRDC Nuclear Notebook," *The Bulletin of the Atomic Scientists*, vol. 57, no. 3 (May/June 2001), pp. 78-79. The Bush-Gorbachev presidential initiatives on tactical weapons were to be implemented by 2000. Whether Russia completed the elimination of tactical warheads it pledged to destroy is not known.

minute notice. This posture and the deterioration of command, control, and early warning infrastructure in Russia have raised concerns about an accidental nuclear launch of Russian nuclear missiles.[8] A different but equally frightening scenario, which some Western analysts considered in the 1990s, involved a seizure of a nuclear-armed missile by renegade military personnel for the purpose of a blackmail or unauthorized nuclear launch. While the Russian nuclear weapons command and control system appears robust at present, a breakdown of the Russian society due to an economic or political crisis, if it occurs in the future, could compromise the existing controls and increase the risk of an accidental or unauthorized nuclear launch.

Safety and Security of Nuclear Weapons

The rapid withdrawal of nuclear weapons from East European countries and former Soviet republics, and massive reductions in the nuclear stockpile due to the implementation of the INF treaty, 1991 unilateral initiatives on tactical weapons, and retirement of obsolete warheads stressed Russia's warhead transportation, storage, and dismantlement infrastructure and raised concerns about safety and security of nuclear warheads. The consolidation of nuclear warheads to approximately 80 locations within Russia was largely completed by 1994 and became a major security improvement. Security and safety of nuclear weapon shipments were facilitated by assistance from the United States and other western countries. The U.S. assistance, administered under the DOD-run Cooperative Threat Reduction (CTR) program, included the provision of nuclear weapon supercontainers, kevlar blankets to protect weapons from small-arms fire, and railcar upgrades.[9] The CTR program continues working with the Russian Ministry of Defense to upgrade security of nuclear weapons in storage and in transit. Because of the weakness of the Russian economy and problems in the military (ranging from an epidemic of mental and emotional breakdowns of individual servicemen to widespread crime and corruption), however, the risk that a nuclear warhead(s) would be stolen or damaged remains.

Security of Nuclear Materials

Perhaps the greatest nuclear security danger in post-Soviet Russia has been the insecurity of vast stocks of nuclear materials. (Nuclear weapons, although at risk, are believed somewhat more secure because their protection is generally better and because they are relatively large and heavy items that are difficult to steal stealthily.) Making weapon-usable HEU or plutonium remains the hardest and most expensive part of a nuclear weapon endeavor and is probably beyond capabilities of terrorist organizations. The existing nuclear powers have invested untold material and intellectual resources in building their stocks of fissile materials and associated complexes of research and production facilities. It, therefore, would be logical to assume that a potential bomb-maker, a nation or a terrorist group alike, would seek an opportunity to short-cut the

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[8] In May 2001, a fire destroyed the Russia's satellite ground control center, which controls its early warning satellites. The national early-warning system became even weaker as a result.

[9] The bulk of CTR funding (approximately $400 million per year) is spent to eliminate nuclear weapon delivery systems (missiles and bombers) and their launcher platforms (silos and submarines). For CTR score card see: http://www.dtra.mil/ctr/ctr_score.html.

effort of production and to acquire fissile material by theft or to buy it on the black market. Because such an attempt could be difficult, if not impossible, to detect, the international community might be confronted with a nuclear threat with little or no warning.

Production, processing, and use of nuclear materials are inherently dangerous because of the risk of material theft. Nuclear materials, however, are particularly vulnerable in Russia due to inadequate protection.[10] Safeguarding nuclear materials in Russia is also difficult because of very large inventories and because of the size and complexity of its nuclear infrastructure.[11] Kilogram quantities of nuclear materials have been diverted from research and production facilities and nuclear stores.

Since 1994, Russia in cooperation with other countries has been working to improve nuclear material protection, control and accounting (MPC&A). These efforts include security upgrades at individual nuclear facilities, development of centralized safeguards programs (such as nuclear transportation security), consolidation of nuclear materials at fewer sites and at fewer locations within individual sites, and measures to increase sustainability of improvements (including personnel training, development of security regulations, etc.). As of 2001, installation of security upgrades was completed at over 25 sites and work was in progress to increase security of additional hundreds of tons of nuclear materials. These achievements, however, represent a small portion of work that needs to be done and MPC&A efforts are expected to continue for at least another decade.

During the 1990s, the United States and Russia launched several other initiatives that are complementary to the MPC&A program. They are intended to secure and reduce stocks of nuclear materials and to increase mutual transparency of nuclear operations. Most important of these include the 1993 U.S.-Russian HEU agreement, the construction of a modern safe and secure facility to accommodate excess fissile materials from dismantled weapons, an agreement to stop the production of plutonium at Russia's remaining three plutonium-production reactors, and efforts to initiate the disposition of excess military plutonium.

Technology Transfers

The design and manufacture of nuclear weapons require highly specialized technologies, materials, and knowledge, international transfers of which are strictly regulated by international and domestic nonproliferation and export control regimes. Some proliferating countries have therefore established elaborate clandestine networks to procure sensitive nuclear-weapon related technologies. Russia's cash-strapped, technology-rich nuclear complex is an obvious and attractive target for such clandestine procurement efforts.

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[10] The inadequate security of nuclear materials in Russia is due to a sharply increased threat and deterioration and inadequacy of Soviet security measures. In the aftermath of the societal crisis of Russia and funding shortages in the nuclear industry, high moral standards and professional discipline of nuclear workers – the key elements of nuclear security during the Soviet times – were threatened by corruption and crime. Other components of the Soviet security system – political controls of the society, closed national borders, and rudimentary technical security systems – either collapsed completely or became less effective.

[11] Weapon-useable nuclear materials are believed to be located at 56 sites in over 400 individual buildings. Ten more relatively small sites are located in former Soviet republics other than Russia.

The Russian-Iranian nuclear cooperation has been particularly controversial. In 1992 and 1995, the two countries signed several agreements and contracts.[12] Some of them, for example, the proposed sale of a centrifuge uranium enrichment facility to Iran, were clearly of proliferation concern. (The centrifuge technology is particularly attractive for clandestine HEU production.) The proposed sale of a centrifuge plant was blocked by the Russian government after the proposal became a public knowledge and because of pressure from the United States. Other projects, for example, the construction of a nuclear power reactor in Bushehr, do not directly contribute to the alleged Iranian nuclear weapons effort. It is, however, believed that the Bushehr project would provide a cover for a wide-ranging access by Iranian intelligence to the Russian nuclear complex and could facilitate clandestine technology-transfer deals with nuclear facilities or individual nuclear scientists. In 1998, the U.S. government imposed sanctions on several Russian nuclear research and training facilities because of their proliferation-sensitive projects with Iran. For example, the Institute of Energy Technologies in Moscow was penalized for its alleged assistance to Iran in developing a heavy-water research reactor. Reactors of this type are particularly suitable for production of weapon-quality plutonium.

Russia's nuclear cooperation with Iran has been the most objectionable from the U.S. standpoint. There are, however, also concerns about its nuclear cooperation with India, China, and some other countries. As in the Iranian case, the concern is that the client countries seek to lure Minatom and the Russian government by a promise of expensive power reactor contracts in order to use this leverage later on to gain access to sensitive weapons-related technologies. The problem is further aggravated because of inadequate enforcement of export control laws in Russia.

Brain Drain

A substantial body of information regarding fissile materials and general design principles and physics of nuclear weapons has become available to the public since the United States and the Soviet Union built their nuclear bombs in the 1940s. However, making a working nuclear explosive device continues to be a technological challenge and requires highly specialized skills and knowledge. Expert knowledge could be pivotal for a success of a nuclear weapons program. For example, competent technical leadership could save years of work and billions of dollars by focusing the program, avoiding duplication and procurement of unnecessary equipment, and anticipating potential problems. To provide such assistance, an individual must have a comprehensive knowledge of warhead design information, and understanding of all stages of development and production of nuclear weapons. Expert knowledge may also accelerate the program by providing support in relatively narrow technical areas such as production and processing of fissile materials, or design and production of nuclear explosives. Russian nuclear weapons experts, for example, estimate that expert assistance can reduce the time of nuclear weapon development to less than a year.[13]

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[12] For a discussion of Russian-Iranian nuclear cooperation see A. Khlopkov, "The Iranian Program for Nuclear Energy Development: The Past and the Future," *Yaderny Control Digest*, vol. 6, no. 3 (Summer 2001), pp. 25-33.

[13] V. Zhigalov, presentation at an international workshop, "Scientists against Nuclear Proliferation," October 1994, Moscow.

Russia has an estimated 10,000-15,000 experts capable of a major contribution to a clandestine weapons program. Of them, approximately 3,000 scientists have a comprehensive knowledge of nuclear weapons. Keeping Russian nuclear weapons scientists at their home institutes working on civilian projects has been the principal objective of several international cooperative programs (most notably, the International Science and Technology Center). Other programs, for example, the U.S.-Russian Nuclear Cities Initiative, seek to create civilian jobs for former weapons experts outside of nuclear weapons facilities.

Nuclear Safety and Environmental Cleanup

The turbulence of the post-Soviet period has increased the risk of a nuclear accident. During the 1990s, the discipline at nuclear facilities declined; many safety programs were neglected; and production equipment became worn out and unsafe to operate because of inadequate maintenance. Several accidents occurred in the 1990s, including a chemical explosion at a plutonium separation facility in Seversk in 1993, and a nuclear criticality accident (an inadvertent chain reaction) at a reactor fuel fabrication facility in Novosibirsk in 1997. (A nuclear accident involving a significant release of radioactivity could result from a terrorist attack against a nuclear power plant or fuel processing facility.) Decommissioning and dismantlement of old defense facilities and management and disposition of radioactive waste are another critical but underfunded task.

Looking Ahead: Russia's Nuclear Weapons and Arms Reductions

Because of economic constraints and block retirement of delivery systems, Russia's nuclear arsenal is projected to decline considerably in the next five to ten years. Russian officials believe, however, that because of the deterioration of and reductions in conventional military forces Russia is more dependent on nuclear weapons for military security than ever. The military doctrine, which was approved by the Russian government on April 21, 2000, no longer contains the Soviet "no-first-use" principle and states that "the Russian Federation retains the right to employ nuclear weapons in response to the use of nuclear and other types of weapons of mass destruction against it and (or) its allies, and also in response to large-scale aggression with the use of conventional weapons in critical situations for Russian Federation national security."[14]

The significance of nuclear weapons to Russia's security was particularly well articulated by Vladimir Yakovlev, a former commander of Russia's Strategic Rocket Forces:

> The role and importance of strategic nuclear weapons in the new military doctrine rests on the fact that the Russian Federation will, in the foreseeable future, maintain its nuclear power status so as to prevent attempts at using pressure or armed aggression against Russia and its allies. NATO's growing superiority in conventional arms and forces over the past few years has led to an objective need for a bigger role for the Russian SNF [strategic nuclear forces]. Today, the Russian SNF caters

[14] Military Doctrine of the Russian Federation, *Rossiiskaya Gazeta* (April 22, 2000).

> very well to the country's geostrategic situation. They are less dependent upon the direction of a possible threat or the composition of a coalition of adversarial countries than conventional forces. The SNF are characterized by their global reach and great destructive power and serve to equalize unfavorable combinations of economic, technological, demographic, and other important national parameters. Both today and in the foreseeable future the SNF will remain the cornerstone of Russia's defense capability and a global political instrument for deterring any possible enemy form aggression against Russia and its allies.[15]

Some commentators suggest that although Russia seeks strategic stability it may be now less interested in a quantitative parity in strategic nuclear forces with the United States. The two countries are struggling to formulate a new relationship that could replace the obsolete Cold War-type strategic framework. While each country pledged to cut strategic forces by roughly two thirds over the next decade their approaches to such reductions are markedly different. The United States would like to provide for flexibility in force planning, to reduce cost of reductions, and to avoid lengthy and complicated negotiations. While, as of early 2002, it agreed to meet Russia's demand for a legally binding agreement, it remained opposed to making reductions irreversible and was planning to keep in storage a large portion of the warheads slated for removal from delivery systems. Russian officials, on the other hand, have indicated that they would prefer a formal agreement that calls for irreversible and verifiable reductions. In part, this preference for a signed agreement and monitoring procedures is due to Russia's believe in the importance of a treaties for stabilizing international relations. This has become a particularly significant foreign policy objective for Russia after the United States announced its plans to pull out from the Anti-Ballistic Missile (ABM) Treaty. It is, however, also clear that to be meaningful significant force reductions must be accompanied by greater transparency on the stockpiles of nuclear warheads, warhead elimination processes, and warhead-production infrastructures.

Regional stability is another critical objective of Russia's foreign and military policy. Russian analysts believe that regional stability could potentially be upset by further expansion of NATO to the East, expansionist policies of Turkey, Islamic militancy on Russia's southern borders, and future threats from Southeast Asia. This explains Russia's increasing interest in tactical nuclear weapons. According to Radii Il'kayev, Director of Russia's primary nuclear weapons design laboratory, "[T]actical nuclear weapons – operative tactical nuclear weapons – are required for Russia. … Our borders are enormous."[16]

There is a concern that Russia might pursue the development and mass-production of new advanced tactical weapons. This would weaken the nonproliferation regime (which is based, in part, on the pledge by the nuclear-weapons states to eliminate nuclear weapons). Development and validation of new warhead designs would probably require nuclear testing, which would undermine the CTB treaty. There is also a danger

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[15] Interview with Col. Gen. Vladimir Yakovlev, *Yaderny Control Digest*, no. 7 (Spring 1998), p. 3.

[16] Quoted in D. Hoffman, "In Once-Secret City, Scientists Consider Russia's Nuclear Future," *International Herald Tribune* (September 1, 1999), p. 5.

that Russia would redeploy tactical nuclear weapons that are currently kept in centralized storage locations to front-line units thereby increasing the risk of their theft, unauthorized use, or a major accident.

The Future of Russia's Nuclear Proliferation Agenda

Russia will have to maintain an active R&D and production nuclear complex as long as it continues to rely on nuclear weapons for military security and on nuclear power for energy production and until it disposes of nuclear materials and radioactive waste. Russia and the international community therefore will continue facing many of the same proliferation, safety, and security dangers that emerged after the collapse of the Soviet Union. The magnitude of the problem, however, could vary significantly depending on the following factors:

- Russia's progress in downsizing of its nuclear weapons complex;
- Russia's ability to maintain core nuclear competence;
- availability of funding;
- political commitment by the Russian government to address nuclear security problems; and
- international cooperation.

Each of these factors is discussed in turn below.

Downsizing of the Nuclear Weapons Production Complex

An orderly downsizing and reconfiguration of Russia's giant nuclear weapons complex to make it smaller, safer, and more secure is an essential element of any strategy to reduce Russia's nuclear proliferation and security dangers. The complex remains oversized for its mission and is still configured for the Cold War. Its downsizing is inevitable. The strategic rationale for maintaining a giant nuclear infrastructure no longer exists and the Russian economy cannot support the Cold-War complex. The technical infrastructure has already contracted due to aging and lack of maintenance. A realistic alternative to the complex's orderly transition would be its continuing decay without consolidation, which could eventually undermine Russia's national security, increase the possibility of a major accident with a nuclear weapon or facility, and dim the prospects for economic development of the surrounding communities.

The trajectory of the Russian warhead production complex is also of critical importance to the United States and other western nations. From the military strategic and arms control perspectives, Russia's over-sized warhead production complex perpetuates the risk of Russia's quickly rebuilding its huge nuclear stockpile if political and economic circumstances change. A decaying massive complex undermines efforts to secure hundreds of tons of HEU and plutonium and increase the risk of proliferation of nuclear weapons technologies and expertise. And a lack of consolidation has major effects on U.S.-Russian cooperative programs. In particular, business development and

nonproliferation cooperation with the closed nuclear cities and associated nuclear facilities would remain inhibited because of restricted access and investment limitations.

The Russian government has developed a complex restructuring program ("On Restructuring and Conversion of the Nuclear Weapons Complex in 1998-2000") and it was adopted by the Russian government in June 1998 as a part of a broader plan to restructure Russia's defense industries. As of 2001, Minatom was working on a longer-range program for 2001-2010 and to 2020. The 1998 program and subsequent planning documents call on Minatom to:

- stop warhead assembly at two out of four Russia serial warhead assembly/disassembly facilities (in the closed cities of Sarov and Zarechny) by 2000 and stop warhead dismantlement in this locations by 2003;

- phase out nuclear weapons work at one of the two fissile material processing plants (in Seversk) in 2003; and

- cut the number of defense program personnel from 75,000 to 35-40,000 by 2005.

Downsizing is also planned for individual facilities and would involve defense personnel reductions and consolidation of weapons activities in fewer buildings and production areas.

Certain steps have already been taken. The production of fissile materials for nuclear weapons has stopped and some plutonium- and HEU production centers are no longer involved in military activities. All research institutes and production plants of the weapons complex have developed and are working to implement facility-level restructuring programs. Warhead assembly work has already been stopped in Sarov and Zarechny. Seversk, which in the past produced HEU and plutonium components of nuclear warheads, has essentially become a civilian nuclear technology center. Drastic downsizing has also occurred at nuclear-weapons R&D and non-nuclear component manufacturing facilities in Moscow and other open cities.

If successful, the implementation of the 1998 program would be an important step in the right direction. The complex, however, would likely remain oversized relative to Russia's projected nuclear arsenal and a second phase of complex's reductions would be called for after the current plans are fulfilled.

A rational approach to optimizing the weapons complex would be to consolidate weapons work at the smallest number of facilities possible and would be based on a cost-benefit analysis of the existing infrastructure, future missions, and stockpile and funding projections. In reality, however, there are many other factors that could influence Minatom's ability to plan and execute the downsizing and restructuring of the complex:

The most significant near-term problem is the redirection of excess workers. Downsizing, particularly in the closed nuclear cities, is not possible unless new jobs or other opportunities are created for the displaced nuclear weapons workers. Indeed, massive layoffs in the closed cities would threaten their social stability and increase the danger of thefts of nuclear materials or proliferation of weapons expertise. Minatom estimates that it needs to create approximately 35,000 jobs in the closed cities by 2005.

Defense conversion and job creation in the closed cities, however, is a challenging task. Their isolation, security restrictions, lack of modern communications and other business infrastructure, and, at some locations, radioactive contamination make difficult the development of normal business relationships. The weakness of the Russian economy and insufficient foreign investment will also continue to inhibit defense conversion at Minatom facilities and economic development in the local communities. Workforce reductions due to retirement, personnel losses to the commercial sector, and minimal new hiring will hopefully relieve this pressure in five to ten years. Massive retirement, however, would increase the need in social protection of and better pensions for nuclear veterans.

Funding shortages is another critical problem. Defense conversion and redirection of excess workers, and consolidation of weapons activities at fewer facilities would all require considerable funding.[17] Until the national economy recovers, the Russian government will not be able to finance complex downsizing activities at a sufficient scale.

Finally, the pace of downsizing would depend on domestic politics in Russia. A decision to terminate defense orders at a large production facility, especially in a closed city, would be politically unpopular (unless attractive non-military jobs are created) and would encounter opposition from facility workers, in the local communities, in the regions, and in the Russian Duma. Pressure from these special interest groups, compounded by the creeping anti-Western sentiment and nationalism, is likely to slow down the downsizing process.

These difficulties are serious and could slow down or derail the downsizing of the complex unless the Russian government and the international community provide strong political support, leadership, and sufficient funding.

Human Resources Crisis?

At present, the Russian nuclear weapons complex is oversized and large personnel cuts are needed to bring it in line with reduced defense requirements and limited budgets. In the longer term, however, the complex could be facing a different human resources challenge: retirement of experienced workers, a continuing outflow of young specialists, and an absence of new high-quality hires could disrupt the continuity of Russia's nuclear weapons competence, undermine stability of the complex, and, eventually, jeopardize its core missions.

According to a local newspaper in the closed city of Snezhinsk,

> VNIITF [the Institute of Technical Physics in Snezhinsk, one of Russia's principal nuclear weapons laboratories] is experiencing significant difficulties because of the outflow of personnel, in particular, of qualified workers. Massive resignations could render the institute incapable of fulfilling state defense orders. This would be a downfall of the facility: in the environment of minimal financing, its customers demand practical results, not paper studies about the

[17] Implementation of the 1998 program, for example, is estimated by Minatom officials to cost $1 billion.

future. The VNIITF management is also troubled by the lack of new hiring. This personnel situation could in the future lead to a self-destruction of the institute.[18]

Nonproliferation implications could be serious. An instability of the complex would heighten the danger of proliferation of nuclear materials, expertise and technologies. Safety and security of nuclear weapons could suffer. Efforts to dismantle obsolete warheads and dispose of resulting fissile materials could be stalled. Decreased confidence in stockpile reliability would increase pressure in Russia to resume full-scale nuclear testing and, thus, undermine the CTBT regime. A shortage of qualified technical experts could complicate negotiation and implementation of warhead transparency and other arms control measures.

To prevent a human resources crisis, the Russian nuclear complex needs a system of training, and an ability to offer salaries and benefits that are competitive with those offered by local commercial enterprises.

Funding

The ability of the Russian complex to perform basic safety and security tasks, its nuclear technology export policies, and the pace of its downsizing will be influenced by the level and stability of funding. Russian government budgetary transfers will remain an important source of funding. In 2002, the projected governmental budget allocations to Minatom's defense program were on the order of $ 400-500 million.[19] Future governmental funding will depend on many variables including the state of the Russian economy and governance, world oil prices, management of the Russian external debt, and other factors.

Export operations are another critical source of revenues for the nuclear complex. As of 2001, the most significant of these were the sales of uranium enrichment services to nuclear power utility companies and sales of enriched uranium to the United States under the 1993 U.S.-Russian HEU agreement. The HEU agreement has been particularly important as it allowed Minatom to maintain social stability at its facilities during the crisis years and to make progress in the areas of defense conversion and nuclear safety. The HEU deal is projected to continue until approximately 2013. Additional HEU purchases by the United States, Western Europe, or Japan could be useful because they could accelerate the disposition of proliferation-prone HEU, finance MPC&A and other nonproliferation programs, and facilitate downsizing of the Russian nuclear complex. An increase in Minatom's nuclear exports to the West in exchange for firm commitments to refrain from nuclear sales to proliferating countries and to spend a fraction of revenues on nuclear security and other nonproliferation-related programs would be another useful approach.

The importation of foreign spent fuel for commercial long-term storage and, possibly, final disposal also could provide Minatom with billions of dollars in revenues a portion of which could be used for nonproliferation, environmental, and safety improvements programs. It is generally believed that modern technologies of storing spent reactor fuel in dry casks are mature and safe. The project, however, is opposed by

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[18] "From Industry's Papers," Atompressa (Electrostal), no. 19 (350), June 1999, p. 4.

[19] "Armor is Strong, and Our Tanks are Fast," Rossiiskie Vesti, October 3, 2001, RVE-No.034, p. 5.

Russian environmentalists who fear that Russia would become a world's radioactive waste dump. There are two additional important concerns. The first one has to do with assurances that revenues from the project would not be diverted to corrupt officials. The second concern is that Russia would use the project to finance a transition to plutonium-based nuclear power, which would involve large-scale commercial production and use of separated plutonium and which would increase the risk of plutonium theft.[20] The United States, which has consent rights over most of spent fuel targeted by Minatom, would have a critical role in making sure that, if Russia indeed gets involved in international spent fuel management business, the project is constructed in such a way as to decrease and not increase nuclear proliferation and safety risks.

Organizational changes within Minatom could also be important. For example, under the scheme that had been proposed by Minatom's former Minister Adamov, the ministry would be effectively divided into two parts: facilities that are capable of generating export revenues and those that are not. (The latter would include the nuclear weapons complex.) The concern then is that such an arrangement would isolate the weapons complex from an important source of funding and could further exacerbate nuclear safety and security problems in Russia.

Political Commitment by the Russian Government

It would be impossible to address effectively the nuclear security and proliferation challenges in Russia without a full and constructive engagement by the Russian government, including its president. Indicators of a true political commitment would include the following:

- strict enforcement of export control rules and fulfillment of Russia's international nonproliferation obligations;
- adequate funding of nuclear security programs and sustained high-level attention to them;
- effective governmental control of the nuclear complex;
- improvements in internal security at nuclear facilities and effective measures to combat crime and corruption in Russia; and
- willingness to support and facilitate international nuclear security cooperative programs.

[20] "Plutonium economy," a long-standing strategic objective of the Russian nuclear complex, would involve irradiation of MOX fuel in fast-neutron reactors. A fast reactor could be designed to "breed" more plutonium in the uranium blanket surrounding the reactor than it consumes. The newly-produced plutonium would be separated chemically from the blanket and used to make new fuel. The nonproliferation disadvantage of this scheme is that a large-scale circulation of plutonium would make it more vulnerable to theft. Also, a proliferating nation could easily mask its nuclear-weapon effort by civilian plutonium activities.

The Putin government has taken several encouraging steps in the nuclear area. In 2001, for the first time in ten years, it fully funded Minatom's state orders. Also in 2001, the government dismissed Minatom's Minister Adamov. It is believed that Adamov was fired at least in part because of his alleged involvement in questionable business dealings and because of his support to proliferation-sensitive projects in Iran. It remains to be seen whether this level of commitment will be sustained and increased over time. Also, while strengthening of the role of Russia's internal security and counterintelligence apparatus generally have been of benefit to nuclear security, it has created a concern about the future of democracy in Russia.

International Nuclear Security Cooperation

The continuation of nuclear security cooperation with the United States and other western countries is another critical factor. Strong and healthy cooperative programs would facilitate

- improvements in security of fissile materials;
- stability and downsizing of the nuclear complex;
- progress in disposition of excess stocks of HEU and plutonium;
- coordinated response to nonproliferation and nuclear security problems worldwide;
- increased transparency of the nuclear complex and operations in Russia;
- cooperative and verifiable reductions in nuclear weapons stockpiles; and
- integration of the Russian nuclear industry into the international fuel cycle and reactor markets.

In contrast, a breakdown in cooperation would isolate the nuclear complex and push it towards cooperation with proliferating nations. The situation at nuclear facilities, the state of their security systems, and the threat environment would be opaque. And security upgrades would either slow down or become stalled. (For example, according to senior Minatom officials, it would take Russia 10-12 years to downsize its weapons complex relying on internal resources only. International assistance could help Russia to compress this timeline to five to seven years.[21])

The United States, Russia, and other participating countries have come to value and rely on cooperative programs as an effective tool to reduce nuclear dangers. Good working relations between U.S. and Russian agencies (for example, between Minatom and the U.S. Department of Energy) facilities, and experts that were established in the course of cooperation enable the two countries to discuss and address highly-sensitive

[21] Minatom's Deputy Minister L.Ryabev, remarks at an international conference "Helping Russia Downsize its Nuclear Weapons Complex," Princeton, March 2000.

nuclear security issues. A coordinated strategy, which includes constructive exchanges in the areas of offensive and defensive strategic weapons, cooperation on nuclear security, nonproliferation, and counter-terrorism, and targeted technical and economic assistance, and which is backed by real money and high-level political attention, could potentially be a cornerstone of a new U.S.-Russian relationship. More positive and closer interactions between the United States and Russia in the aftermath of the September 11, 2001 terrorist attacks will hopefully lead the two countries to pursue this strategy.

The future of nuclear cooperation, however, should not be taken for granted. Taxation of assistance funds by Russia, ineffective program management in the United States, and real or perceived use of funds by Russia to bolster its nuclear weapons capability could be the end of cooperative programs. Deterioration of the overall U.S.-Russian strategic relationship, linkages between nuclear security cooperation and Russian-Iranian nuclear and missile exchanges, and restrictive counterintelligence and security policies in the United States and in Russia could also be a serious problem.

Conclusion

Two factors were of critical significance in shaping the field of international peace and security after the Cold War: the emergence of nuclear security and proliferation dangers in the wake of the Soviet collapse, and the unprecedented level of cooperation between Russia and other countries to address these problems.

There are presently no definite answers about the future of the nuclear security agenda in Russia. What is clear is that nuclear security and proliferation risks will remain serious as long as there remain their underlying causes: the oversized and underfunded nuclear complex, the economic turmoil, and crime and corruption nation-wide. An international isolation of Russia would aggravate the problem. On the other hand, economically-prosperous Russia, the rule of law, and a smaller, safer and secure nuclear complex would make nuclear risks manageable. The integration of the Russian nuclear complex into the world's nuclear industry, increased transparency of nuclear operations, and cooperative nuclear security relations with the United States and other western countries are essential to reducing nuclear dangers and preventing catastrophic terrorism.