A Roundtable Discussion on the Warhead Safety and Security Exchange Agreement between the Russian Federation and the United States[1]

Introduction to the Roundtable by Siegfried Hecker

The Nuclear Warhead Safety and Security Overview, the Timeline, and the collection of other papers in this chapter provide background on how the Warhead Safety and Security Exchange (WSSX) agreement was reached and perspectives on how it helped improve the safety and security of Russian and US nuclear weapons. To provide some of the personal backdrop for the beginning of the WSSX program, we asked key lab specialists and government officials who paved the way to tell the story of how it got started. Some of the participants quoted here gave their views in person at a roundtable at Stanford University in December 2012. Others contributed through a virtual roundtable conducted by email, telephone, and in-person conversation through August 2015.

The Early Days of Lab-to-Lab Cooperation, Leading to WSSX

◆◆ (to Lev D. Ryabev, Minatom/Rosatom[2]) We cooperated in some areas that were quite sensitive, like warhead safety and security. How hard was it to convince your government that cooperation in these areas was necessary and beneficial?

Lev Ryabev: This was not a major problem. Viktor N. Mikhailov and the scientists at each institute were professionals with many years of experience, and they knew where the boundaries lay. There were clear areas where cooperation was good and necessary and did not present security or confidentiality problems. In many cases, we could collaborate on interesting scientific questions, and that collaboration would have benefits for the weapons programs without jeopardizing security. For example, we worked together on stockpile stewardship and the science that supported it through joint work on computing, modeling, magnetic explosive generators, and other areas of physics. This cooperation did not provide practical solutions that were applicable to nuclear warheads, but it deepened our understanding of fundamental science and stimulated an intellectual scientific atmosphere at our institutes on these issues. This in turn had positive impact on Russian scientists working directly on stewardship of our nuclear weapons. I dealt with some of these security issues with the International Science and Technology Center (ISTC), where I was responsible for vetting projects. At ISTC, I could tell immediately what projects were possible and what were not possible. I felt that the programs on nuclear warhead safety and security were important and not too sensitive to allow us to cooperate.

[1] The individuals and their affiliations are listed at the end of this paper.
[2] The Russian Federation Ministry of Atomic Energy (Minatom) was established in late January 1992. It became Rosatom in March 2004.

◆◆ It seems a big step to talk about scientific cooperation on nuclear warheads. Did you see warhead discussions as a big step or just the next logical part of discussion?

Ryabev: We anticipated it and knew that we needed to discuss the warheads issue at some point. There was no way to deal with these issues except through cooperation—the alternative was to return to the time when we opposed each other. It was crucial for both sides to derive benefits from this cooperation, as I told Rose Gottemoeller of the US Department of Energy (DOE). If only one side was benefiting from the cooperation, there would be suspicion.

Everything we did was focused on how to reduce the nuclear dangers we faced. The professionals understood this and they wanted to cooperate on warhead issues. All of the security programs—WSSX, physical protection, control and accounting—grew out of professionals wanting to work together.

◆◆ (to K. David Nokes, Sandia National Laboratories [SNL]) From the beginning, Sandia played a key role in joint efforts to work with the Russians to ensure nuclear weapons safety. How did you get involved?

K. David Nokes: My involvement in Russian collaboration was accidental. My career was based on weaponry, not collaboration. I began to work with the Russians late in 1991. A Soviet delegation (still Soviet Union for another month) led by Mikhailov came to Washington at the end of November just as the Nunn-Lugar Cooperative Threat Reduction (CTR) program was making its way through Congress. We were asked to address ways in which the United States could assist the Soviet nuclear weapons labs. Mikhailov was most interested in assistance with emergency response equipment and with plutonium storage containers. The Nunn-Lugar CTR legislation authorized the United States to help the Soviets with the safe and secure transport, storage, and dismantlement of nuclear, chemical, and other weapons.

◆◆ (to Jerry Freedman, SNL, Department of Defense [DoD], and DOE) You were involved early on when you were still at Sandia. When did you first meet with the Russians?

Jerry Freedman: My efforts with the Russian Federation began in mid-1992 under the Nunn-Lugar CTR program. Sandia was tasked with (1) establishing a working interface with the Russian Federation and (2) developing an accident-resistant container for the safe transport and long-term storage of pits. The containers needed to meet stringent International Atomic Energy Agency (IAEA) criteria, which are compatible with similar US Nuclear Regulatory Commission criteria.

The principal Russian point of contact for the container project was Rady Ilkaev. The US container team met Ilkaev in the summer of 1992 at Omaha, Nebraska. It was immediately apparent to our delegation that we could easily work with Ilkaev. He subsequently headed a Russian delegation that visited Sandia in December 1992. The focus of that visit was to review container specifications and the results of preliminary impact and fire tests, with a goal of finalizing the design.

◆◆ (to Rady Ilkaev, VNIIEF) The trips to Omaha, Los Alamos, and Sandia in 1992 were your first to the United States. Had you met Americans before?

Rady Ilkaev: Before this trip, I met with the Americans only during talks at the Foreign Ministry. It was very interesting to observe how step by step, trust grew stronger and internal suspicions gave way to a desire to professionally engage with emerging issues.

◆◆ What was your objective for the trips to America? Who asked you to go? What were your impressions?

Ilkaev: After the Chernobyl disaster most nuclear weapons specialists in Russia believed that ensuring nuclear safety must entail not only organizational measures but also scientific and technological solutions that may dramatically reduce the influence of the human factor. We were facing a multifaceted task. It was necessary to choose the areas of collaborative work with the American experts that would be useful to us while not touching on sensitive research areas. The US side was ahead of us in the technical means of safety and we were interested to learn about the American technologies.

At the suggestion of Georgi A. Tsyrkov, head of a main directorate of Minatom, a Russian delegation visited Sandia National Laboratories to get familiar with technologies and equipment designed to eliminate possible accidents involving nuclear weapons. The meeting at Sandia was very successful because the topic was completely understandable and completely unclassified. Moreover, Tsyrkov—an excellent professional and a respected leader—led our delegation.

◆◆ How did the collaboration develop?

Ilkaev: The first years of cooperation were devoted mainly to the safety of nuclear weapons technology. Those years showed that there existed some very serious tasks; that there was a desire to solve them as quickly as possible and that solid results could be obtained within a short time.

It was a successful start (for example, development of the containers for transporting fissile material and nuclear warheads). It showed that if we could collaboratively achieve success in such a sensitive area, one related to the safety of nuclear weapons technology, we would do equally well in all other fields of science. That was exactly what happened later.

◆◆ (to Paul White, LANL) How did you get involved in these early meetings?

Paul White: In the summer of 1992, Sig Hecker asked me to be LANL's principal point of contact for all its activities in support of CTR. In a way, this closed a loop, as I had earlier met with Russian counterparts during the Geneva negotiations for the Joint Verification Experiment (JVE) and later participated in the lab directors visits described in Section I of this book. As the LANL CTR point of contact, I met with Russian counterparts who came to Los Alamos in connection with these activities. In December 1992, the Russian

specialists who visited Sandia also visited Los Alamos to discuss the design of a fissile material storage facility to house and monitor nuclear materials recovered from dismantled Soviet nuclear warheads. This was one of Mikhailov's highest priorities.

At the sidelines of the meeting, the Russian participants asked for a meeting with American specialists to discuss nuclear warhead dismantlement. During this discussion, as detailed in this chapter's Overview, the Russian experts noted that while warhead dismantlement was proceeding according to plan, there might be some issues that could slow progress, and that some level of cooperation might help. Ilkaev noted that any cooperation in such a sensitive area would have to be carefully managed. He also mentioned several specific areas for potential consultation.

To me, this seemed like an unprecedented opportunity to move into a whole new arena for cooperation and to address some problems not being covered in other arenas. It was clear, however, that our governments needed to be involved, and I agreed to take appropriate steps to involve them.

◆◆ (to David Nokes) How did you proceed at Sandia?

Nokes: On the US side there was broad agreement that we should work on surety (safety and security) as a mechanism for engaging in meaningful topics and avoiding classification concerns. The economic difficulties at the Russian laboratories made this work crucial. We faced many problems because the US bureaucracy was geared to preventing collaboration with the Russians. For example, everything had to be done through an interagency process, which was a very cumbersome, and many of the individuals at the different government agencies still viewed Russia as our enemy. The early process was not well coordinated, and the labs were not provided any funds. In other words, this was nobody's day job.

Under the auspices of a government-to-government process, we began the Safety, Security, and Dismantlement (SSD) program in 1992.[3] In early 1993, while awaiting a government-level response to the Ilkaev proposal of the previous December, Sandia initiated a lab-to-lab activity we called the Surety Technology Initiative (STI). Sandia was supported by internal funds provided by Sandia Vice President Roger Hagengruber. Roger put me in charge of this activity. We also brought in the other US weapons laboratories. No one in Washington was willing to say no to this activity, and a few, such as Vic Alessi at DOE and Anne Harrington at the State Department, were willing to say yes. The State Department approved our holding joint seminars with the Russians.

◆◆ (to Roger Hagengruber, SNL) What made you take the initiative to launch the effort with the Russians at Sandia? When did you first meet your Russian counterparts?

Roger Hagengruber: When the directors of the physics labs went to Russia—Director Siegfried Hecker of LANL and Director John Nuckolls of Lawrence Livermore National Laboratory (LLNL), along with John Immele (LANL) and George Miller (LLNL)—Director Al Narath of Sandia was invited. However, the invitation came late, and we decided that the political risk was high enough that Narath thanked them and

[3] SSD was the original name of the Nunn-Lugar CTR program.

declined. At that time, there were many in Congress who resented the labs for their role in such initiatives as the Strategic Defense Initiative (SDI). The next year, I sent Paul Stokes to Moscow to test the waters, joking that if they let him come home, we would then send a senior delegation. In 1993, I arranged to tour the Russian labs, taking John Crawford and Tom Hunter with me. The trip went very well, and we identified many opportunities to collaborate on safety, security, and conversion. When I returned I set up a $1-million account out of the weapons program to fund an office to coordinate interactions and to seed collaborations—in weapon safety especially but also to find opportunities for joint research programs. Stokes ran the office until he went to Vienna, and then Clyde Layne ran the office for a short time before Nokes took over. During my trip to Russia, I met with the lab directors, deputy directors, and my counterparts. We were treated very well and saw an amazing array of test and lab facilities.

Sandia was unique in setting up that $1-million account to ensure that we focused on collaborations and on helping the Russian labs maintain stability and in not on trying to make money out of the relationship. Historically then, Sandia spent 80 percent or more of that government funding in Russia and not in our lab.

The rules of the road were (1) treat our Russian counterparts with respect and with empathy for the difficult situation they were in, (2) drive a hard bargain and don't throw money away, and (3) always keep your word. I was told by State and some of the senior Russian people that Sandia was an excellent partner and well respected.

It was my view that we had a historical opportunity to establish a respectful and permanent friendly relationship with our Russian counterparts and, in so doing, bring an end to the Cold War atmosphere and create and enduring framework for understanding and collaboration. Until the DOE starting getting involved on site—and some individuals began exploiting the Russians—the effort worked very well and would have flourished and lasted much better than it has.

◆◆ As you reached out to the Russians with tangible fiscal resources, what did you hope to accomplish collaborating with the Russian nuclear laboratories? Were you satisfied with the outcomes?

Hagengruber: We set out to help the smart but insular Russian labs and scientists to see the human side of us and to see that we were sincere in wanting to help them retain their institutions, jobs, and scientific pursuits in a post–Cold War world. I had no interest in rubbing in any "winning of the Cold War" sentiments, and I felt that for Sandia, working jointly on safety, security, arms control, conversion, and basic research would be a sound investment in future peace between our nations. I was very pleased with the progress and the relationships that we had until the government got too involved in a rather naive way, wasting money and tainting the relationships. Also, a variety of companies and former government officials sought to exploit the efforts with Russia for personal gain. This situation caused similar parasitic forces to rise in Russia and encouraged the Russian Federal Security Service to become hard-nosed in the face of "nuclear tourism," perceived exploitation, and the failure

of many to honor commitments with the Russians. It is a true shame of epic proportions that something that was a highlight of the end of the Cold War became bloated and dysfunctional and a contributing factor in residual cynicism and suspicion here and in Russia.

True, we continue to celebrate ongoing relationships and collaborations, but they are a small example of what might have been.

◆◆ (to Jerry Freedman) You were working on the pit container project under CTR. What do you remember most about the first discussions with the Russians?

Freedman: There were several delicate issues that had to be addressed such as the size and heat-generating capability of Russian pits. Ilkaev quickly developed an understanding of the container requirements and the design, development, manufacturing, and testing criteria that had to be met. Because Ilkaev was focused on moving the project forward as rapidly as possible, he sorted out the essential issues that needed to be addressed and summarily dismissed nonessential issues, but only after careful consideration of the facts.

The December 1992 visit to Sandia also provided an unexpected lifetime opportunity for lab employees to work technical issues with Russian specialists. In spite of the language barrier, communication with the Russian delegation was effective and generally easy, and the Russians were found to be quite personable. It is interesting to note that repeated visits to Walmart were a priority. The Russian specialists, most of whom had never visited the United States, told us that their perception of the United States at the end of the one-week visit was considerably different than what they expected.

There were some lighter moments during follow-on meetings. During the Russians' visit, a fax was sent to Ilkaev from the Russian embassy in Washington, DC. The fax noted a news story that several Russian nuclear weapons scientists were removed from an airplane because of their destination—apparently, North Korea. Ilkaev's response was, "Well, we know it isn't any of us."

◆◆ *(*to Rady Ilkaev*)* As you look back at the beginning of the collaboration, why did it get off to such a good start?

Ilkaev: In my opinion, this period bears historical significance. As in the Second World War, our countries and our specialists demonstrated how effectively they can work together. The most qualified scientists and engineers were swiftly brought in to address the issues of nuclear safety, a key technology for any nuclear power. The reasons for the fast and efficient work, in my opinion, are as follows:

First, the specialists of the two countries were excited to get to work together. Both we and the Americans were well aware that, on a global scale, the circle of researchers engaged in nuclear technology and, specifically, in its defense applications was very small. Therefore, for our participants in the cooperation, getting to know [American] specialists in the same

field meant a new stage in their career and, essentially, a way out of isolation. Second, we solved national-level problems, which was a serious moral incentive.

Third, the decision to collaborate—with specific projects specified, as much as possible—was signed off by our countries' top leaders, which made it possible to avoid most of the bureaucratic difficulties. This was a demonstration of a simple rule: when all levels of leadership and the scientific and technical community have a unity of purpose, the work goes with extraordinary speed and brings everyone great moral satisfaction.

I would like to emphasize the role of our exceptional Minister Mikhailov in the organization of the successful cooperation between Russia and the United States. He was very well aware that it was essential to establish cooperation at the level of both leaders and experts.

◆◆ (to Paul White) Paul, you said you reported the December 1993 Los Alamos meeting to Washington, but got no response. What broke Washington's silence?

White: The laboratories rather forced the issue. Thanks to Hagengruber's support, we set up the tri-lab (Sandia, Los Alamos, and Livermore) STI, which Nokes led. Under this rubric, we were able to have productive, mutually beneficial engagement with our Russian counterparts without a formal governmental agreement. We received appropriate permissions from the Departments of State and Energy, and arranged initial meetings with representatives of the Russian weapons laboratories during the summer of 1993.

Our US team included experts from the three US weapons laboratories and a DOE representative. Our first meeting was in Ekaterinburg, at the Russian Academy of Science's Institute of Metals Physics, with a delegation of more than two dozen scientists and engineers from VNIITF. There were also a representative from the Mayak Production Association (Mayak PA) [a plutonium-production facility] and an observer from VNIIEF. The Russian group was led by Academician Evgeny Avrorin. A lasting first impression from this meeting was that of being warmly greeted on our first day with a cry of, "Коллеги!" (Colleagues!), as we rounded the top of the stairs leading to our meeting hall. That greeting set the collegial tone for the discussion, July 6–8, 1993.

◆◆ (to David Nokes) Dave, was the Ekaterinburg meeting the first of several?

Nokes: We were astonished by getting such a big welcome from Avrorin and the VNIITF delegation. Immediately after the meeting in Ekaterinburg, the US group returned to Moscow and met with Ilkaev and other VNIIEF experts at Minatom. In fact, Mikhailov was the official host for those discussions. With understandings developed in these exploratory meetings, we followed up in rapid succession with an STI workshop on accident-resistant containers in Albuquerque, New Mexico; hazardous materials in Snezhinsk; and energetic materials at Livermore. In August 1993, we had a formal meeting with the Russians at which we had government-issued talking points, discussing for the first time the framework for a formal government-to-government agreement. By the end of September 1993 (end of the US fiscal year), we had 40 STI projects underway with Russian colleagues. The projects were

valued at $500,000. By that time we had already interacted with several hundred Russian nuclear specialists. These efforts paved the way for the WSSX program. The STI projects were all in the spirit of WSSX and materials protection, control, and accounting (MPC&A).

◆◆ (to Evgeny Avrorin, VNIITF) Do you remember who it was in that 1993 delegation in Ekaterinburg that gave the Americans such a big welcome? What were the expectations at VNIITF for the first of these workshops?

Evgeny Avrorin: The first US-Russian meeting on cooperation in the field of ensuring security was held in Yekaterinburg July 6–8, 1993. A conference room for the meeting was kindly provided by the Institute of Metals Physics, the Ural branch of the Russian Academy of Sciences. All the necessary arrangements for the meeting were done by Oleg V. Buryakov and Vladimir N. Ananiychuk, VNIITF specialists, and Sophia N. Petrova, the institute's scientific secretary. Six US and about 30 Russian specialists, including Starodubtsev of Mayak PA and V. N. Voronov of VNIIEF, took part in the meeting. Both sides agreed to conduct two workshops, one on risk assessment (Russian-side coordinator, Stanislav F. Babin) and another on transportation security (Russian-side coordinator, Vladimir M. Yuzhanin). The meeting participants had a preliminary discussion of the possibility of cooperation in the area of the safe handling of explosive materials. It was believed expedient to create a glossary on the topics under discussion. The workshops were supposed to be funded through organizational fees and through collaborative research under lab-to-lab contracts. Those agreements were confirmed by a memorandum of July 12–14, 1993, in Moscow.

The primary US participants in that meeting were David Nokes, Paul White, and Patricia Newman, who all later took an active part in cooperation with the Russian Nuclear Centers.

◆◆ (to Evgeny Avorin) The 1993 meetings with the Americans were not the first ones for you. You already had an opportunity to work with US colleagues during JVE test in Semipalatinsk in 1988. What were your impressions, and what role did the two JVE tests play in further joint activities such as WSSX?

Avrorin: For me, the JVE tests became determinative for the entire follow-on cooperation. JVE tests were unique. Both sides gained a certain level of trust in each other. And for me, that was the most important JVE result.

During the JVE tests, we learned how to work together at the edge of the classified task area. While preparing for the JVE, the Russian side raised the point that the other side might acquire sensitive information from electromagnetic interference in the cables associated with the hydrodynamic method of measuring yield. At first, it was difficult to formulate that concern without disclosing sensitive information. Then a way out was found: the high-frequency part of electromagnetic pulse could be filtered out because it was not needed for measurements with the hydrodynamic method.

◆◆ (to Paul White) What were the results and benefits of these meetings during the summer of 1993?

White: The most substantive result of these meetings was, of course, our joint commitment to press forward with the series of STI symposia. We all realized that STI was but a temporary solution while we worked on more formal arrangements through our governments. At the same time, and less tangibly, we got to know each other better. For some people, these were first-time encounters, while others were renewing acquaintances from other venues, for example, JVE and CTR. But these meetings in Ekaterinburg and Moscow were relatively informal, unencumbered by strict government protocols. So personal relationships grew and continued to the present day. One should not underestimate the importance of the continuity of these relationships. Trust grew out of repeated encounters and enabled the continued development of forward-leaning programs like WSSX.

◆◆ (to Rodion I. Voznyuk, VNIITF) How did you get involved with the Americans and then in WSSX?

Rodion Voznyuk: In the 1980s I led an analytical unit at VNIITF. The unit's task was to conduct ongoing comparative analyses of the strategic nuclear stockpiles of the Soviet Union and other nuclear powers. Of course, we understood that the nuclear weapon stockpiles of the USSR and the United States were excessive and we needed to curb their further growth. We believed that real steps to limiting nuclear weapons depended on the increase of trust between the USSR and the USA.

The JVE, conducted at the nuclear testing grounds of both countries, was quite important. But then we thought that it was a one-off event and that its importance was going to wane with time. The visit of Secretary of State James Baker to Snezhinsk in February 1992 became another important step. The exchange visits of the directors of US laboratories and Russian institutes that transpired after Secretary Baker's visit gave another impetus to the process.

Initially, all areas of nuclear cooperation were related to the physical protection, accounting, and control of nuclear materials. This collaboration resulted in a series of workshops that showed that further cooperation on safety and controlled dismantling of nuclear weapons was possible only with an appropriate intergovernmental agreement.

When the Nunn-Lugar program became active, we disguised some of the lab-to-lab programs as Nunn-Lugar programs because lab-to-lab had no funding at that time. Ryabev, first deputy minister of Minatom, supported our proposals for possible projects. His role in starting the cooperation was crucial.

Of course, we have to realize that this time was difficult for Russia. Russia faced significant economic challenges, but the economic reasons were not the principal driver for this cooperation. What was important in my mind was the mutual desire to start a face-to-face dialogue with our American colleagues. I agree with Dave Nokes, the workshops and

symposia played a very important role because they provided the opportunity for our security people to see that scientists could talk without violating any security regulations.

I believe the WSSX program came about because of this discussion. In the end, personal relationships were very important.

◆◆ (to Alexei Sokovishin, VNIIA) VNIIA was the Russian counterpart to Sandia labs, how did you and VNIIA become involved?

Alexei Sokovishin: This similarity helped in building effective cooperation with SNL, as well as with other US national laboratories. The key role in the cooperative efforts with the US national labs was played by Yuri Barmakov, director of VNIIA, and German Smirnov, VNIIA's chief designer. They managed to establish personal contact with the management of the national labs and the US Department of Energy and provided for the effective cooperation through their active involvement. Strong support of the cooperative activities was also provided by Arkady Brish, one of the living legends of Russian science.

Our first technical result came through SSD, as Nokes pointed out. We gained experience with cooperation in a technical area that was very sensitive. The next step was much easier after this initial cooperation. The number of people involved in lab-to-lab cooperation expanded exponentially.

◆◆ (to Arkady A. Brish, VNIIA) You have had a long-time, legendary association with VNIIA. What were your earliest recollections of working with the Americans?

Arkady A. Brish: I came to the United States for the first time in the early 1990s. Our very first meetings with the experts from the US labs showed that the American colleagues were in fact serious professionals and serious scientists. I had a favorable first impression, which was confirmed and reinforced later.

It follows from my personal impressions that in the areas of technical cooperation, it is possible to find a common language with the Americans. They perfectly understand the danger of nuclear weapons, and they are concerned about this issue, while taking account of the differences in the types and designs of the weapons.

Speaking about the early stage of our collaboration with the American colleagues, I have a clear memory of my trip to America and a presentation at a meeting devoted to safety issues. These issues were discussed at a level of understanding that was to be expected at that time. The Chernobyl accident was then still fairly recent, so neither we nor our foreign colleagues had a full grasp of this event and its consequences.

At the beginning of our cooperation, it was very important to break the set stereotypes about each other—to get to know the foreign colleagues and create a positive ground for productive interaction. Early on, the Americans proposed the idea of having me come to the United States and conduct a series of lectures for US specialists. Minister Mikhailov supported the idea, but he told me it was fine to explain our broad approaches but not to go into details.

I visited Sandia National Labs in Albuquerque. I can remember that I talked in a spacious lecture hall before a large audience who listened very attentively and asked questions. It was my perception that my talk made a positive impression on the audience. I was trying to convey my thoughts on the role of nuclear weapons as a peace factor. At the end of my visit, they gave me a beautiful plaque to keep as a memory. I keep it at home.

I must say that the Americans are very likable people. Those with whom I communicated were polite, smart, and attentive. Over the course of my visits to the United States, I especially remember Patricia Newman of Sandia Labs, who was very cordial with us and very mindful of our needs. She was the first who met us at the airport, and we set the schedule of our visit with her. Patricia was also in charge of our cultural agenda: she accompanied us to museums and organized our sightseeing. We visited the nuclear weapons museum in Los Alamos: the exposition was engagingly organized and beautifully laid out.

Another contact of ours was the director of the Sandia Labs, Paul Robinson. We had a great relationship, with no arguments or misunderstandings. We could see that the Americans are pragmatic and superb workers. Believe it or not, it is very hard for me to find a reason to criticize how Americans work

◆◆ What do you believe are the biggest accomplishments of lab-to-lab cooperation in which VNIIA was involved?

Brish: I hold important not only the technical interaction but also the human contacts that developed between the Russian and American nuclear specialists. I think that this kind of cooperation makes the world safer. Had we not discussed the safety issues with the American colleagues, this area would have been unjustifiably ignored, in spite of being very important.

The collaboration between the Russian nuclear weapons complex and the American national labs on weapons safety issues was productive and pushed us to move forward, compelling us to work and advance. Chernobyl became a glaring example of why an accident involving nuclear weapons could never be allowed to happen. A megaton nuclear detonation would mean the end of an entire region. Those who develop nuclear weapons understand this well. They need to communicate with their country's leaders and keep them informed about the consequences; they need to have a say in ideology and decision making. At the present moment, the idea that there can be no winners in a nuclear war is deeply rooted in the public mind. It was we, the makers of nuclear weapons, who conceived this idea and brought forth the theory of nuclear winter because we have a clear understanding of how these weapons work. Therefore, our collaboration appears essential to me.

◆◆ (to Yuri N. Barmakov, VNIIA) You were VNIIA director when the collaboration began. What are your recollections of the early interactions with the Americans?

Yuri N. Barmakov: My first direct interactions with US specialists took place in the beginning of November 1989 as part of a modest Minsredmash[4] delegation, headed by

[4] Ministry of Medium-Machine Building, later to become Minatom, the Russian Federation Ministry of Atomic Energy.

Deputy Minister Yuri I. Tychkov and including Yu. E. Sedakov, director of the All-Russia Scientific Institute of Measuring Systems (NIIIS), in Nizhny Novgorod: Yu. D. Nikitsky, director of the Tenzor factory, in Dubna; and Yuri N. Barmakov, director of VNIIA, Moscow. The delegation visited the Seagate facilities located in Santa Cruz, Scotts Valley, and Fremont at the invitation of T. Mitchell, president of Seagate Inc. The aim of the trip was to further an idea suggested by Tychkov and Mitchell to launch a joint venture and produce magnetic disk storage devices at the Minsredmash facility in Zhelty Vody (Ukraine), which was within the USSR at that time. VNIIA took part in the project as a party that could provide design support to serial production of the data storage devices. Those interactions didn't concern nuclear weapons issues and just addressed our interest in development in civil areas at the threshold of the thaw in relations with the USA. Activities to establish the joint venture progressed until the decay of the USSR in 1991 prevented project implementation.

My next trip to the USA took place in April 1993, when I was part of a large Minatom and Ministry of Defense (MOD) delegation led by Viktor A. Gubanov. Twenty-five specialists from Minatom and MOD enterprises visited several US nuclear facilities, including the North Anna nuclear power plant, Wellington, Knoxville, Oak Ridge National Laboratory, SNL, and LANL. The major purpose was to study MPC&A issues and solutions in the USA. VNIIA didn't have or use significant amounts of nuclear material in its activities, except that we used tritium in neutron production tubes. However, in 1992, considering our experience developing radiation-monitoring equipment, we suggested to Deputy Minister Vitaly F. Konovalov that he assign VNIIA to be Minatom's head enterprise for MPC&A hardware support. The appropriate Minatom order was issued, and as a result we started participating in all interactions with US and EU specialists with respect to this problem.

In September 1993, an SNL delegation headed by the SNL president, Paul Robinson, visited VNIIA. We discussed and determined additional areas for our interactions. In February 1994, a delegation from three US national nuclear laboratories and headed by DOE representative David McConagha visited VNIIA. Minatom HQ Head Georgi Tsyrkov took part in that meeting. A memorandum of understanding for cooperation between VNIIA and the three US laboratories was signed, defining a number of areas for future cooperation. In October 1994, taking advantage of the start of WSSX, we submitted a huge package of proposals (54 topics) on cooperation projects, and in February 1995, during a VNIIA delegation visit to SNL, the first eight contracts were signed.

◆◆ What were your impressions during these interactions with the Americans?

Barmakov: These interactions, especially with nuclear weapons specialists, were very memorable. It was the first time we freely discussed issues that, during the Soviet epoch, not all Russian specialists were allowed to deal with. The coincidence not only of common interests but also of individual emphases on key aspects—such as safety, the nonproliferation of information about nuclear weapons, neutron pulse generators, and so

on—was pleasantly amazing. I must confess that initially there were two stimuli for us—curiosity and materialistic interest. At that time, even modest contracts were a great help. However, as the financial and economic status of our institute improved (and it was actually essentially better than that of the other Minatom enterprises) our interests shifted towards scientific and technical problems. Unfortunately, by the time this shift became evident (by the early 2000s), interactions with the US national laboratories had started slowing down.

In general, those active interactions with the US national laboratories during the first 10 years were very useful. Especially constructive was work on super-containers, regulatory documents, and hardware solutions in the area of MC&A and on neutron generators and telecommunications equipment for videoconferences. Regular participation (currently continuing) in conferences on systems safety, global nuclear materials management, and other topics was very useful. And we didn't divide areas of cooperation into that related to, for instance, WSSX, lab-to-lab, or some other agreements. For us, all of them were just interactions with the US national labs.

I should mention several "semi-worldly" impressions. In 1993 at Oak Ridge, we were taken to an MC&A laboratory. I noticed that there were used on-site computers and printers that were far from being state-of-the-art and were produced in the middle of 1980s. The answer to my question, "Why don't you change them?" was the following, "What for? They work well enough." That answer ruined the stereotype that only ultramodern equipment was used in the USA.

In 1995 at Sandia, we had lunch in a canteen with Paul Robinson. During our talk he said that just the next day he would fly to Washington to wring out money for some project. That was nice for me, as it buried the second stereotype that the Americans easily got everything, and money flowed to them like water.

In 2000 we showed an SNL delegation headed by Hagengruber and Joan Woodard our civil achievements in the field of industrial control for nuclear power plants, neutron generators, and pressure transducers. Once everything had been viewed, our American guests said that if everybody in Russia worked the same as VNIIA did, Russia would be another country. Perhaps, it was just a polite exaggeration, but firstly, it was pleasant, and secondly, that ruptured the third stereotype, that the Americans did not notice somebody else's success.

◆◆ (to German Smirnov, VNIIA) You were chief engineer at VNIIA at that time. What are your first recollections?

German Smirnov: The first time I participated in a Russian-American meeting was in 1991 in Moscow. The negotiations were conducted by our diplomatic officials, while nuclear weapons specialists just watched. However, when Dave Nokes demonstrated the representative American container for nuclear munitions, I immediately understood that he was as professional as we were and a very fascinating and well-meaning person. He also sincerely sought to facilitate the return of all the Soviet nuclear weapons to Russian territory and the destruction of their components, as was stipulated in the Russian-American treaty and was in the interests of both countries.

In April 1992, I visited Albuquerque, SNL, and Kirtland Air Force Base as a member of a Russian delegation. There we got acquainted with scientists of the US national labs and better understood the essence of the Nunn-Lugar program. Patricia Newman played an exceptional role in creating an atmosphere of mutual trust.

By 1994 (when the WSSX agreement was signed), after some more meetings of specialists of the two countries, the purposes of and potential for implementing the agreement became clearer. SNL's John W. Kane and I were appointed co-chairmen of one of the three technical working groups (TWGs)—TWG-B. It dealt with the least-sensitive issues of nuclear warhead storage and transportation safety, and it was therefore easier to move forward and to develop and deliver to Russia a great amount of different equipment, including means of protection, railway cars, hardware, tools and instruments for emergency response teams, and many other things. These deliveries allowed accelerated destruction of redundant nuclear weapons, and the exchange of scientific and technical information enriched American and Russian concepts to ensure nuclear safety and drew them closer together. But the main outcome was the warm feelings that I will keep forever and the tens of American friends whose names remain dear to me, as patriotic for their own country as I am for mine.

The Official WSSX Program

◆◆ (to Paul White) How did we get from the Surety Technology Initiative Symposia to the WSSX agreement?

White: We always understood the STI symposia to be a bridge, an interim step that would allow governments time to come to grips with the notion of formally exchanging information directly related to nuclear warhead safety and security. And indeed, even as the first STI symposia were being planned and executed, our two governments were moving forward. During an August 1993 meeting in Albuquerque with Ilkaev, we discussed what should be involved in a formal agreement. Ilkaev was prepared because he had discussed these issues with Russian officials before the meeting. At the same time, the new US administration was making progress in its comprehensive review of national security policy and had authorized preliminary discussions with our Russian counterparts for October 1993, immediately following the first STI symposium. These symposia continued the process of building relationships and establishing trust, and they helped governments see more clearly the potential benefits of engagement and gain confidence that laboratory experts could handle such sensitive discussions.

By the time the US government authorized formal negotiations, the high level of trust and understanding already built up among the scientists enabled rapid progress. The Russians had already tabled a draft during our October discussions, and our first round of negotiations occurred in February 1994. It only took two other brief rounds in the spring and early summer before a final document was initialed. The official WSSX agreement was then signed in December 1994 by Secretary of Energy Hazel R. O'Leary and Minister of Atomic Energy Mikhailov.

◆◆ (to Jerry Freedman) You had moved to Washington from Sandia around this time to work in the office of the Assistant to the Secretary of Defense for Atomic Energy. How were you involved there?

Freedman: I was on assignment at the DoD, and in that capacity, I was a member of the team that met with Russian representatives at the American embassy in London in December 1995. Ryabev, deputy minister of Minatom at the time, led the Russian delegation and Victor (Vic) Reis, of DOE, led the US delegation. The meeting was one response to the October 1995 Clinton-Yeltsin Hyde Park summit, at which the two presidents agreed to have technical experts from both nations discuss areas of scientific and technical cooperation under a Comprehensive Test Ban Treaty (CTBT). The meeting was of great importance to the Clinton administration, and Steve Andreasen of the National Security Council (NSC) represented the White House.

During the meeting in London, I posed a question to Deputy Minister Ryabev: "What is your single greatest concern about ensuring that the Russian stockpile can be maintained under a CTBT?" His answer was "People." He went on to explain that with time, subtle changes to nuclear weapons will be made and those without nuclear design and test experience will not be able to recognize or correctly assess the effect and risk associated with these changes. The issue of subtle changes remains a concern today even though both nations have maintained their stockpiles without nuclear testing for some 20 years.

Specific potential topics for each working group were identified in a subsequent meeting in May 1996. Although the stage was set for science and technology cooperation, many obstacles and thorny issues remained. For example, based on a meeting between Minister Mikhailov and Secretary of Energy O'Leary, the Russian side was under the impression that the United States would provide modern high-speed computers to the Russians. However, transfer of this class of computers was prohibited by the Department of State and the Department of Commerce. Despite the efforts of DOE Assistant Secretary for Defense Programs Reis, with State and Commerce, access to the desired computers was never achieved. This issue remained a sore point in relations for quite a few years.

Nevertheless, the results of this meeting helped pave the way for the March 1996 Presidential Decision Directive 47 (PDD-47) on scientific and technical cooperation related to nuclear stockpile safety and security and CTBT monitoring and verification.

◆◆ (to Paul White) Was the 1995 London meeting the official start of WSSX? What role did PDD-47 play if it was not signed until March 1996?

White: As the record shows, Minister Mikhailov and Secretary O'Leary signed the WSSX agreement on December 16, 1994, and it went into force on June 1, 1995. So WSSX activities were well underway by the time of the London meeting in December 1995 and the official signing of PDD-47 by President William (Bill) Clinton in March 1996. Unbeknownst to laboratory scientists, the national security review going on in the Clinton administration was laying the foundation for cooperative activities such as those enabled by the WSSX agreement and then extended as a result of the Reis-Ryabev meetings, which began in London.

◆◆ (to Steve Andreasen, NSC) You were working these issues in the National Security Council (NSC) at the time. How did PDD-47 come about, and what is your recollection of the timing of the different events?

Steve Andreasen: As White implies, PDD-47 had roots that trace back to the earliest days of the Clinton administration. When he took office in January 1993, President Clinton directed the NSC to conduct a comprehensive review of a broad set of national security issues. This was driven partly by the standard practice of a new administration determining which national security policies should remain in place but more immediately by urgent nuclear weapons issues prompted by the dissolution of the Soviet Union in December 1992. A fresh look was needed to address the fate of nuclear weapons in the successor states; to consider the implications for the Strategic Arms Reduction Treaty (START), which had yet to enter into force; and to explore questions related to nuclear testing. These latter questions concerned pursuit of a CTBT, the monitoring of such a treaty, and for the country's nuclear stockpile, the implications of not testing.

So over the following months, the administration steadily articulated its emerging position in each of these areas, both through a series of Presidential Decision Directives (PDDs) and in public statements. This developing guidance addressed a comprehensive range of nuclear security issues in 1993, from strategic arms control to pursuit of a nuclear test ban and from stockpile stewardship under such a ban to verification of a CTBT. We see formal administration guidance appearing in concert with understandings from bilateral and multilateral diplomatic efforts, such as the Vancouver Summit of April 1993. At the same time, we see a growing body of experience in dealing with Russia, from the CTR program to the growth of lab-to-lab initiatives after the lab directors' visits and the birth of cooperative efforts related to the safety and security of nuclear weapons. There was steady evolution throughout the period from 1993 to 1995 towards a consistent pattern of cooperation, ultimately embodied in PDD-47 (March 1996).

◆◆ Now that PDD-47 has been declassified, we see that it was a document with enormous foresight and a great belief that cooperation was critical. How much faith did you and President Clinton have that the nuclear specialists could work together productively on such sensitive subjects?

Andreasen: As I just noted, this document was the culmination of several years of experience, consultation, and deliberation. Cooperation was a recurring theme dating from the George H. W. Bush's Presidential Nuclear Initiatives (PNIs) and Gorbachev's immediate response. The theme of cooperation was echoed in face-to-face meetings between President Clinton and President Yeltsin, and it was reinforced in a growing body of experience with expert-to-expert interactions. Problems of nuclear safety and security, including for nuclear weapons, were a shared concern. They demanded new forms of cooperation, and we were seeing for ourselves that cooperation was possible. The themes of PDD-47 came together rapidly in late 1995 with high-level consultations in Moscow, the Hyde Park summit in October, and the US-Russian agreement on a zero-yield CTBT. The further understandings reached during the December 1995 Reis-Ryabev meetings in London and the Moscow summit of April 1996 on nuclear safety and security led directly to the ideas about cooperation embodied in PDD-47.

◆◆ Was PDD-47 driven strictly by the desire to complete the CTBT, or were there other motivations for the directive?

Andreasen: By no means! The objectives of this directive must be seen in the context of the comprehensive national security review that was initiated by the Clinton administration in January 1993. A range of national security objectives was addressed through PDD-47. For example, the guidance explicitly states that one purpose was to "[c]ontribute to greater transparency and to the safe and secure maintenance and drawdown of the Russian nuclear stockpile. . . ." Another was to "Sustain the scientific competence of individuals responsible for ensuring confidence in the Russian and US nuclear stockpiles." And, of course, sustaining a safe and secure stockpile was a common objective of both countries. So, this directive was not just aimed at the CTBT; it was of fundamental benefit to US policy objectives.

◆◆ (to Lev Ryabev) Did the Russian government develop a document similar to the American PDD-47?

Ryabev: Nothing as detailed as PDD-47. The political guidance from the government (namely President Yeltsin) was very general. It stated that we needed (1) a CTBT, (2) zero yield, and (3) comprehensive monitoring. From that guidance, Minatom (namely Mikhailov and Ryabev) discussed these. Then, the specialists in nuclear institutes wrote the detailed instructions. Of course, the Minatom people did have to work under the general coordination of the Ministry of Foreign Affairs (MFA), and Grigory Berdennikov chaired the group. As for the details of the WSSX agreement, Minatom wrote the details under the general direction of MFA. That draft was then given to the government (that means the administration).

◆◆ (to Jerry Freedman) What was your role now that you were in the US government?

Freedman: Between the London meeting in December 1995 and the next Reis-Ryabev meeting in Moscow in June 1996, the number of Russian proposals for science and technology cooperation increased quickly. We were challenged as to how to describe and package these topics so as to pass inspection by wary officials from both sides. Whereas we could support the Russian side in many of these projects, we struggled to find funds to support the specialists on the American side. That continued to be a problem during the entire time of our joint "technical diplomacy."

On June 24, 1996, the Moscow Protocol for the Implementation of Scientific and Technical Projects to help ensure the safety and security of US and Russian nuclear stockpiles under a CTBT was established. It was also known as the Reis-Ryabev process, after the two officials given the responsibility of developing the protocol.

It is interesting to note that Ilkaev and I had worked the thorny issues relative to collaboration with such intensity that neither one of us chose to attend the signing in Moscow of the protocol document that we had prepared.

◆◆ (to Evgeny Avrorin) At this point, the labs had the approval to proceed on the incredibly wide range of topics covered by the WSSX agreement and the Reis-Ryabev protocol. How did the labs and institutes respond?

Avrorin: Prior to the cooperation, nuclear weapons labs and institutes did not have direct contact, and their work was aimed against each other. Nonweapons labs and institutes in our countries had had contacts before that. Joint work during the lab-to-lab activities led to tight interaction of the weapons centers. The lab-to-lab cooperation had the strongest effect on the nuclear weapons labs. The WSSX cooperation was quite remarkable on very sensitive topics. A full list of lab-to-lab contracts in which VNIITF was involved over the years is more than 14 pages long. The total financial support in US dollars was quite large. Contracts under the WSSX program and lab-to-lab projects had a significant scope in multiple areas (for example, nonintrusive detection of nuclear weapons, safe and secure transportation of nuclear weapons, material properties under extreme conditions, and technology for explosive devices). Even political aspects were considered, such as the possibility of a nuclear-free world. And basic astrophysics was an area for lab-to-lab cooperation. Multiple MPC&A projects helped to significantly upgrade the appropriate systems at VNIITF, playing their positive role for the USA, as well. The total financial assistance looks very impressive. I should note with regret that in the recent years cooperation became less intensive and less broad.

◆◆ How did the other laboratories that were involved respond to the WSSX program at this time?

Jeff Richardson (LLNL): Our participation in the WSSX program was primarily driven by technical capabilities in emergency response and radiation detection. For example, Roger Ide, who led the lab's participation in the Nuclear Emergency Search Team, organized one of the four early workshops, the one held in Sarov in June 1997. This accident response workshop focused on safety and security of nuclear stockpiles. It covered the following general topics: (1) organizational structure of nuclear accident response procedures and technology, (2) assessment technology, (3) predictive modeling capability and the minimization of consequences, and (4) training and exercises and the safe handling of damaged weapons.

It was quite remarkable to be able to discuss such sensitive topics at the workshops. One of the most interesting collaborations was on techniques removing high-explosive components that were stubbornly adhered to other components within warheads. In 2000, LLNL specialists presented their work on using dimethyl sulfoxide (DMSO) to dissolve high explosives from key US warhead components. Reaction from the Russian warhead safety specialists was immediate and unequivocal, with an announcement that the United States "has given us a gift." Who would have imagined during Soviet days that one day we would help them with the technical means of taking apart their nuclear weapons?

Vladimir Rogachev (VNIIEF): During my career at VNIIEF, I was working in the area of plasma physics. In 1996, I became head of the International Department of VNIIEF's Theoretical Division, and then in 1998, I became deputy director of VNIIEF. First, everyone

will agree with me that we were witness to important events, such as changes in our country and international collaboration, something not possible during the previous 50 years. Safety and security for our nations and for other countries were important. It is important to emphasize that each side wanted to be safe and secure. Both sides believed that it was important to solve the urgent problem of Soviet weapons in the other countries of the former Soviet Union. The fact that the nuclear threat had increased led to WSSX, and since our interests coincided, that led to our success.

For WSSX, we had some resistance inside Russia. We did not agree on many details associated with this agreement. Some agencies balked and got concerned about it. I signed the first WSSX contract for VNIIEF. We have had a few tens of contracts related to WSSX, but let me point out that we also had many in other areas.

Olga Vorontsova (VNIIEF): Before the start of the WSSX program, VNIIEF had already carried out cooperation with the US national laboratories, particularly with LANL, under the MPC&A agreement, as well as in the lab-to-lab framework. In my opinion, these first, pre-WSSX contacts allowed us, to a certain extent, to be assured that there was no threat to the Russian side and no possibility of leakage of sensitive information, as well as to ascertain that we were on a par, that is, that neither party had a critical advantage in its designs. The WSSX program was needed due to the problems outlined by Afanasiev in his paper. More precisely, those were (1) the signing of the 1993 START II treaty and the increased possibility of accidents during transportation of nuclear warheads and (2) the presence of a threat new to Russia, such as from an "insider" terrorist (absolutely unthinkable in the Soviet Union). The threat of insider terrorism was probably another motivating factor for closer exchange of information in the areas specified in the WSSX agreement. Let me note that the agreement from the very beginning envisioned co-financing, that is, a financial contribution from the Russian side. This demonstrated the interest of the Russian side. Unfortunately, financial conditions in the 1990s did not allow this to happen. As it is, at all times, not just for WSSX, the inequality of direct financial contributions was hanging over the relationship like the sword of Damocles. I also should note, though, that some of the projects that were carried out at VNIIEF under the program were financed from VNIIEF's funds.

The first seminars within the WSSX framework evoked great enthusiasm, at least in VNIIEF. Before that, collaboration with American colleagues was pretty narrow (high-energy-density physics and fences). The workshops allowed specialists in gas dynamics, designers, and materials scientists to engage in cooperation. We began very active and productive work with SNL.

Andrey Sviridov (VNIIA): Our work on WSSX was focused on the safe dismantlement of nuclear warheads and on data exchange. We tested fiber-optic sensors, active well coincidence counters (AWCCs), nuclear materials identifiers, and techniques for verification of nuclear warhead identity. We also worked on catalogs of nuclear materials transportation containers, multichannel identification systems for dismantling warheads, and active systems for detecting nuclear materials in luggage and explosives in containers, as well as fast inventory systems for nuclear materials.

Together with Sandia, we conducted experiments on and testing of the Automated Monitoring and Inventory System (AMIS) (abbreviated in Russian as ASMI, from *Avtomatizirovannaya Sistema Monitoringa i Inventarizatsii*) developed under WSSX. This Russian system is a set of technical capabilities for monitoring the condition of a nuclear warhead in its container and is designed by Russian nuclear weapons institutes and Russian commercial companies. Experiments and tests were carried out for conditions of storage and motor vehicle transportation. Specialists and leaders of the 12th GUMO of the Russian Federation were informed of the test results. Interestingly enough, at the same time, Sandia developed the Platform T-1 control system. We tested a T-1 system supplied by Sandia at VNIIA, and Sandia tested an AMIS system supplied by VNIIA. This cross testing proved the operability of our systems and their functional similarity.

Thanks to 12th GUMO support we were able to proceed to the TOBOS project (from the Russian name, *Tekhnologii Obespecheniya Bezopasnosti Opasnykh Sistem*). The purpose of the project was to transfer the AMIS monitoring technique to a 12th GUMO facility and to test it through the efforts of specialists from 12th GUMO institutes.

After thorough discussions, the 12th GUMO leadership offered to use, for testing under the TOBOS project, sites of the Technical Systems Safety Research Center of the Ministry of Defense of Russia, located in the north of Saint Petersburg. AMIS-storage, AMIS-vehicle, and AMIS-train systems were tested on the institute sites. Thus, as far as I know, the AMIS-TOBOS project was the only one within WSSX where there was active participation of both US and Russian nuclear weapons laboratories and institutes (Sandia and VNIIA) and specialists of the US and Russian military agencies—the Defense Threat Reduction Agency (DTRA) and the 12th GUMO. After the TOBOS project expired, work on implementation of some technologies tested under the AMIS-TOBOS project was carried out at the facilities of the Russian Federation MOD.

As you see, in our cooperation, we tackled important sensitive issues, engaged military specialists, and jointly achieved success.

Sokovishin: My cooperative work was focused mostly on Sandia National Labs. At first, almost all the cooperative efforts were carried out in the framework of lab-to-lab collaboration, which passed the sustainability check during the Russian financial crisis of 1998. After 9/11, the focus was drawn towards counterterrorism.

In the course of all the joint efforts, we obtained solid experimental results, important for both our nations. In recent years, the situation has become more complicated due to the lack of any official intergovernmental agreement. In my mind, one of the most important achievements under the WSSX program was the fact that we learned not to be afraid to cooperate in sensitive areas.

White: From the outset, work under WSSX was grouped under three categories, and one US and one Russian expert co-chaired each of the corresponding working groups. Cooperative activities on safety and security related to dismantlement were led by scientists from VNIIEF and LANL. Similarly, work on safety and security of nuclear components through external means was organized under the leadership of VNIIA and SNL, and interactions on handling sensitive information and emergency response was led by VNIITF

and LLNL, as noted by Richardson. Of course, LANL scientists and engineers participated in activities under all of the working groups, including especially emergency response and warhead safety and security. In particular, we organized workshops on high-explosives safety and, stimulated by the LANL experience with the Cerro Grande fire, a series of seminars on mitigating the impact of fire on nuclear facilities. Perhaps because of the sensitivity of the warhead dismantlement topic, we organized only one workshop on dismantlement safety—but it was a quite notable one, as Richardson has previously observed.

◆◆ (to John Ruminer, LANL) How did you become involved in WSSX?

Ruminer: I was head of the Los Alamos Weapons Engineering Division at the time. I was asked to lead a DOE delegation to Sarov in June 2000 for a workshop with the Russians on nuclear weapon dismantlement. On our side, this included all three weapons labs; Pantex, our weapon assembly plant; and representatives from the Nevada Test Site and DoD. Since most of us were weapons engineers, we had never met our Russian counterparts. My co-chair from VNIIEF was Vladimir Afanasiev. It was a remarkable meeting. There were many memorable presentations and much valuable discussion, but we all recall that one of the highlights was the LLNL presentation mentioned by Richardson on high-explosives dissolution using DMSO. We went away confident that the Russian safety procedures for weapon dismantlement were as rigorous as ours. In fact, even their paperwork requirements were as onerous as ours—which may just mean that it's the right thing to do.

A Brief Look at the Later Years of WSSX

◆◆ (to Paul White) Could you briefly summarize some of the key events in the history of the WSSX program in the later 1990s—its first renewal and then its later years?

White: WSSX activities were off and running as soon as the agreement was signed (December 1994) and even before it entered into force. As early as February 1995, experts met to generate lists of topics for technical exchanges. The first workshop was held by the end of November, and more than seven other symposia were held during the first five years of the agreement's existence. There were numerous other smaller-scale interactions and information exchanges during this period. Perhaps the most significant event was the "Russian-American Workshop on Safety of Nuclear Weapons Dismantlement," held in Sarov in June 2000. This was the first formal exchange to directly address some of the dismantlement safety concerns that initially stimulated pursuit of the agreement back in December 1992.

As might be imagined, almost every technical exchange generated new ideas for further discussions. Technical interactions continued within the original scope of WSSX. Activities within the original scope of WSSX extended into such areas as lightning protection, comprehensive weapon system safety assessments, human factors and insider threats, emergency response to wildfires near nuclear facilities, and many others. It was also during this later WSSX period that the TOBOS project described by Sviridov was fully implemented.

◆◆ What's the Russian view? Andrey Sviridov, you were heavily involved by this time, traveled many times to Sandia, what is your view? How did you get from the 56 proposals VNIIA first submitted to real work? How did the effort change over the years?

Sviridov: Those 56 proposals were discussed in detail at VNIIA and prepared October–December 1994 and the first half of 1995. Our proposals referred to such areas as materials science, physics of fast processes, safety components, and so on. Therefore, I consider them to be proposals within the lab-to-lab cooperation program with Sandia. Serious formal discussion of the proposals under the WSSX agreement started after the familiarization tour of US DOE laboratories by VNIIEF, VNIIA, and VNIITF specialists, November–December 1995.

I agree with Yuri Barmakov's opinion that in the first stage of our cooperation, we did not try to formally relate certain project proposals to different areas, such as WSSX, MPC&A, material science, electrophysical equipment, counterterrorist technologies, and so forth.

I would like to note that VNIIA involved its best specialists in joint projects under both WSSX and MPC&A, as well as in material science. They tried to carry out work in the scheduled time and with good quality. As a result of cooperation with US nuclear laboratories, many VNIIA specialists gained new knowledge and experience by presenting their own work at international conferences and workshops.

◆◆ (to Jerry Freedman) What happened to the WSSX program after the first five years?

Freedman: I officially transferred to DOE in the spring of 1996 and, as a federal employee, remained as the principal point of contact for scientific and technical cooperation under the Reis-Ryabev Protocol until I returned to Sandia National Laboratories in March 2006. So this is my view from Washington.

By the start of fiscal year 2003, it was apparent that both the funding and the topics that were permitted for cooperation were diminishing. This was despite efforts by DOE Under Secretary Ernie Moniz in 2000 and continuing efforts by General John Gordon, administrator of the National Nuclear Security Administration (NNSA). Contract approval had become more difficult on both sides because of perceived liability issues associated with cooperation and the Russian insistence on a more formal government-to-government agreement. The Moscow Protocol was not considered to be a formal agreement. This led to diminished cooperation and ultimately to only annual meetings for presenting technical papers and exchanging ideas. These meetings at least maintained contact between US and Russian technical experts without contracts.

Greg Mann (SNL): We were motivated by tackling big, important projects. Working with VNIIA before the WSSX renewal in 2000, we had jointly established AMIS, a prototypical warhead monitoring system. AMIS laid the foundation for execution of the much larger TOBOS program during the last five years of WSSX.

Sviridov: AMIS and TOBOS may have been the only WSSX efforts in which there was active participation by 12th GUMO representatives. Of course, both Minatom and the

Ministry of Defense were designated as the active Russian participating organizations under WSSX. I think this joint participation is another reason we can regard the TOBOS project as one of the more successful ones in the later years of the agreement.

White: One of the significant changes in the later years occurred when the agreement was renewed in 2000. Our two countries added to the scope of work under WSSX by agreeing, in a deliberately ambiguous statement, to cooperate in the area of nuclear warhead dismantlement. With this newly opened doorway, the laboratories began a significant program of work related to transparency measures during dismantlement processes. Dozens of workshops, information exchanges, and projects were conducted under the umbrella of this new topic, and cooperation in these areas extended the list of participating institutions in both the United States and Russia. However, our governments have never chosen to make use of these technical capabilities in any practical way. They remain on the shelf for possible future use.

Voznyuk: Many of these new technical activities went beyond the technical domain. The total number of such projects undertaken by VNIITF was close to 50. And this is probably typical for other institutes as well. Among other things, we developed a transparent dismantling scenario and corresponding model that could be used to train inspectors and to develop specific dismantling technologies.

Vorontsova: I think this illustrates one of the problems with WSSX—that the boundaries of what we were to do became less well defined. There was an expansion of topics into less-well-defined areas. The topics strayed far from safety and security of nuclear warheads. The expansion of WSXX topics had happened already by 2000, but the general outlines of the program still applied. Apparently, it was no longer purely an exchange of technical information because contract work was already going on quite intensively. But it still had to do with improving safety and security. VNIIEF projects 2000–2005 included not only interactions with LANL, SNL, and LLNL but also successful cooperation with Oak Ridge National Laboratory, the main contact person being John Mihalczo, and with Pacific Northwest National Laboratory, the lead person being John Smoot. These projects gave us the opportunity to conduct some quite costly experiments that provided information on the quantitative and qualitative analysis of the characteristics of nuclear materials by nondestructive measurement. They also enabled introduction of the protocols and devices needed to detect and identify nuclear material.

◆◆ (to German Smirnov) What was the biggest challenge for joint activities and how was it overcome?

Smirnov: We didn't have any troubles with joint activities during the period the intergovernmental agreements were active. By our mutual evaluation, the results were important and useful, and for these reasons, specialists from both countries made efforts to extend the period of validity for the WSSX agreement, to significantly enlarge the areas of cooperation, and to increase the number of working groups.

◆◆ The WSSX agreement was allowed to expire in 2005. Many Americans view this as part of the Russian Federation tightening its security and generally drawing down cooperative interactions with the United States. But others, including some Russians, believe the United States was making renewal difficult by introducing new liability concerns. Were these the only reasons, or had the program simply served its purpose? Or were there other reasons for its demise?

Mann: I think we, the Americans, also took our eye off the ball. We were loading down the WSSX program with other projects. It was no longer just the weapons labs with their initial safety and security focus.

Voznyuk: WSSX was to focus on information exchange in nonsensitive areas, but we began to run into more-sensitive categories. For example, we wanted to work on computer modeling of dismantlement, but the authorities did not agree. We also saw the terms "transparency" and "arms control" come into the WSSX collaborations. Transparency referred to dismantled warheads. It is difficult to stay at a conceptual level in such areas; you have to get specific. The authorities rejected this effort as well. All of these things could have contributed to the demise of WSSX. As we approached 2005, the end of the agreement, the politicians told us in 2003 not to sign any new contracts.

Richard Smith (SNL): At the beginning, we kept our focus on safety and security, with modest levels of funding. Around 2000, things changed; there was a significant injection of funds and much of the new funding was not necessarily a part of the real WSSX, as we saw it. We moved into nonproliferation, monitored disassembly, and transparency. I saw it for the most part as moving toward an arms control focus, which in turn brought in all the other DOE labs.

Robert Huelskamp (SNL): I think it came apart because we lost the single-minded focus on execution of safety and security projects. Also, early on we had good support from both the US DoD and the Russian Federation MOD, but in 2000 that link began to break. We also lost the "X" in WSSX, meaning the exchange part. Also, more of the nonweapons labs became involved; that also contributed to a loss of focus for the program. Other objectives were brought into the program—such as arms control, disarmament, and nonproliferation—instead of the program sticking to safety and security. We were also driven to smaller projects by DOE Headquarters, and the program began to follow more of the ISTC model instead of the lab-to-lab model. Funds from the nonproliferation programs at DOE went to the Russian labs, but none to the US labs.

Jose Saloio (SNL): I also found a change to more US labs and more federal oversight. We also diversified the topics away from the initial focus. By 2006, we had no new projects, and we wrapped things up in an orderly manner by 2009.

Vorontsova: As we approached 2005, the contracts became smaller and deeper, meaning more sensitive. We had three fields of collaboration: information we were unable to exchange under any condition, information that could be exchanged only between American and Russian specialists, and information that could be exchanged freely around the globe. The WSSX program was largely confined to a narrow bilateral exchange. It had a clear-enough objective—the exchange of technical information in sensitive areas via

well-coordinated exchange procedures. One of the achievements of the program was the development of these procedures.

But, as I mentioned earlier, the program began increasingly to propagate to areas not related to those specified in the agreement. Other Russian institutes—nonweapons entities, such as the Institute of Physics and Power Engineering (IPPE), the Khlopin Radium Institute, and so forth—began to be involved in the work. At some point, a conflation of programs began to happen. For example, contract proposals appeared that were close to the subject matter of Nuclear Cities Initiative cooperation that is described in Section IV of Volume II. Increased security measures played a role to some extent. The expansion of the scope of cooperation can be divided into two areas: (1) a shift to conversion, that is, technology commercialization and the creation of jobs, which evoked Rosatom's concern and ultimately had an impact on the nonrenewal of the program, and (2) expansion into the area of scientific and technological cooperation.

There are not very many qualified nuclear professionals, and they are concentrated mainly in the weapons laboratories in the US and Russia. Basic research, the importance of which increases due to the CTBT, is expensive—this determines the inevitability of scientific and technical cooperation between weapons laboratories and institutions. One attempt to realize this scientific and technical cooperation was the extension of the WSSX agreement. This option was supported by the Russian side. When the agreement was extended in 2000, both parties agreed on the wording that allowed for scientific and technical cooperation. In 2006, the US side proposed two additional documents: "On Intellectual Property" and "On Liability." The discussion of bureaucratic and legal technicalities took a lot of time and effort, while the legal basis for the conclusion of new contracts was not established. In 2008, Sergei Kiriyenko (prime minister of Russia), sent Thomas P. D'Agostino (US DOE/NNSA) a letter, which proposed to abandon the expanded language and start preparing a separate agreement on cooperation in the field of basic and applied research. Some of the projects were proposed to be conducted in the framework of a 123 Agreement,[5] once it had been signed.

So, yes, the program, if one perceives it in terms of the objectives of the 1990s, exhausted itself. But it established formats and demonstrated the possibility of sensitive cooperation between the parties in the absence of political friendship.

White: I also think that one of the key problems was the entanglement of WSSX objectives with other programs, for example, the fissile materials storage facility and transparency. We may have done this with the best intention, but it had consequences. Some activities that should have been handled under CTR became subject matters for exchanges under WSSX. For example, there was concern on both sides about obligations associated with US CTR support for the Russian fissile material storage facility and transparency measures for operations at that facility. We began looking at transparency techniques, thinking that they would be applied to the storage facility. It is true that Russia agreed to the addition of technical exchanges in this area when WSSX was renewed in 2000. However, in practice, cooperation in this area got closer and closer to sensitive areas, and the work diverted attention from the core WSSX issues of nuclear weapons safety and security.

[5] An agreement on the conditions and processes for nuclear cooperation between the United States and another country, which is required under Section 123 of the US Atomic Energy Act of 1954.

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Paul Robinson, Yuri Barmakov, Arkady Brish, Joan Woodard, and German Smirnov at lab directors meeting banquet, Santa Fe, NM, 1999.