

US ASSISTANCE TO RUSSIAN CHEMICAL WEAPONS DESTRUCTION: IDENTIFYING THE NEXT STEPS

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Russia has a stockpile of some 40,000 metric tons of chemical weapons (CW) agents. Destruction of this stockpile would minimize the chances that these weapons might be used in future conflicts, make the weapons inaccessible for use by terrorists, and remove a major threat to human health and environmental safety. For these reasons, the United States became by far the largest foreign donor to the Russian chemical demilitarization (chemdemil) program, obligating (as of January 31, 1999) over \$139.6 million to the effort.¹ However, the program is now behind schedule and has lost most of its funding from Congress. Russian chemdemil thus needs restructuring and innovative new approaches if it is to regain momentum and fulfill its mission.

US assistance to Russian chemical demilitarization is part of the Cooperative Threat Reduction (CTR; also known as Nunn-Lugar) Program, which originated in late 1991 in the wake of the breakup of the Soviet Union. The original motivation for the program was a fear of Soviet "loose nukes," with the result that chemical and biological weapons issues were relegated to the back-

ground.² In fact, the money so far allocated to CW is less than 10 percent of the total CTR funding obligated for nuclear and other projects.

Further, the record of US-Russian interaction on chemical weapons has been disappointing. The original expectation was that because CW assistance involved weapons that neither side produced any longer and both had designated for destruction as militarily irrelevant, the cooperation would proceed smoothly and become a CTR "success story." This mutual interest led to several cooperative agreements, including the 1989 Wyoming Memorandum of Understanding (MOU) and the 1990 Bilateral Destruction Agreement (BDA). Both the United States and Russia also signed and ratified the Chemical Weapons Convention (CWC), which entered into force in April 1997 and requires complete destruction of stockpiled chemical weapons by 2007. The bilateral agreements, however, were often characterized by mutual suspicions and in some cases by the reluctance of the Soviet/Russian side to promote transparency and reciprocity. Moreover, the BDA never came into force, despite intensive negotiations after its signing. It is also

now clear that Russia will have great difficulty meeting its CWC obligations.

This report will evaluate the progress made so far towards destroying Russia's CW stockpile, offering recommendations for breaking through both technical and political roadblocks. We begin by describing scientific cooperation on developing CW destruction technology, then describe the diplomatic and internal Russian political factors that have affected implementation of the chemdemil program. We conclude that while cooperation between the United States and Russia on CW disarmament has been good at the scientific level, discord at the diplomatic, political, and administrative levels has sometimes impeded effective collaboration. Such problems might be minimized by pooling donor resources to provide Russia with complete, turnkey solutions to CW destruction, rather than treating collaborative programs as a "jump start" to the underfunded and often abortive Russian efforts. In addition, it is essential to better incorporate local communities into the process, by intensifying efforts to ensure the long-term environmental and health safety of destruction technologies and by providing people living near proposed destruction sites with information about processes and safeguards. The time has also come to revisit the Russian Federal Program of CW Destruction and identify new options that would be less costly and more feasible in Russia's dire economic environment. Successful elimination of Russia's CW stockpile will require flexibility and greater awareness of the needs and limitations of all stakeholders in the process.

EVOLUTION OF THE RUSSIAN CW DESTRUCTION TECHNOLOGY AND THE ROLE OF CTR

Until about 1970, the United States, Russia, and other nations often disposed of unwanted stocks of chemical agents by crude means such as open-pit burning, land burial, and ocean dumping. The quantity of toxic agents dumped in the ocean after World War II has been estimated to be as much as 100,000 tons,⁴ more than all such material known to be stored worldwide today. It became clear that these methods carried unacceptable risks to human health and environmental safety. Open-pit burning of CW material and other toxic chemicals was replaced by controlled incineration. The US Army intends to use incineration as the major destruction technology at five of its nine CW storage sites. Public oppo-

RUSSIA'S CW STOCKPILES

Although generally known as "poison gases," most CW agents are actually liquids. For use in warfare, they would be dispersed as an aerosol mist by spraying or explosive detonation. There are two major types of CW agents: *blister agents*, such as mustard gas, and *nerve agents*, including sarin, soman, and VX. A third class, *choking gases* like chlorine and phosgene, was used extensively from 1915-1918, but is not a major part of current CW stockpiles. The blister agents, developed during World War I and produced in massive quantities during World War II, cause terrible, slow-to-heal burns on contact with skin. Blister agents can be lethal if inhaled and are also carcinogenic, often inducing skin cancer years after exposure. Russian blister agents include mustard gas and lewisite, an arsenic-containing chemical.

Nerve agents cause rapid death through the disruption of nerve-impulse transmission in the central nervous system. Sarin, the "nerve gas" used in the Tokyo subway attack in 1995, is a volatile liquid whose vapor can be absorbed readily by the lungs. In contrast, VX has low volatility and persists on surfaces for long periods. It is readily absorbed through the skin and is highly toxic. As little as one drop may be lethal to a normal-sized human.

Russia's stockpile of blister and nerve agents is stored at seven major sites, six in western Russia and one in the Kurgan region near Shchuchie, east of the Ural Mountains.³ The Shchuchie site stores mainly nerve agents contained in missile warheads and artillery projectiles. There are also smaller quantities of the choking agent phosgene, but this part of the stockpile is not included in the CTR-funded activities. Phosgene is a standard industrial chemistry and could either be recovered for industrial use or destroyed by common industrial procedures. Most CTR support for Russian chemical disarmament is directed towards destruction of the nerve agent-filled weapons stored at Shchuchie.

sition to incineration, however, has led to consideration of alternative destruction technologies for use at the other four American sites.⁵

The Russian Ministry of Defense (MOD) had originally planned to destroy chemical agents by neutralization followed by incineration in large, regional facilities. One such facility was under construction at Chapayevsk in Samara oblast, but it was never completed because of public opposition to CW destruction in this area. Widespread opposition to the original plan led to a rethinking of the CW destruction strategy. The concept of transporting chemical weapons to regional destruction facilities was replaced by a decision to destroy the weapons where they are stored.⁶ Along with the decision to destroy CW at the storage sites, the choice of destruction technology was revised.

In 1994, after study of many non-incineration technologies, the MOD selected a two-stage technology developed by the Moscow-based State Scientific Research Institute for Organic Chemistry and Technology (GosNIIOKhT).⁷ Russia's insistence on its two-stage destruction process, though it had not been developed beyond the laboratory bench, was apparently motivated by several factors. One was political, in that by MOD officials perceived transfer of a US-approved CW destruction technology as undesirable. Promotion of an indigenously developed technology would create jobs and demonstrate Russia's stature as an advanced industrial nation. Another argument was that Russia should not make its strategically important chemdemil program dependent on the import of foreign technology—especially from the United States, a country with a long record of imposing trade sanctions. Also, the Russian MOD was highly skeptical about its ability to operate and maintain high-tech incineration facilities, which would require much greater technological sophistication than the two-stage destruction process.

In the first stage of the Russian process, the nerve agent is treated with a chemical reagent that *neutralizes* or dramatically reduces its toxicity. For the volatile nerve agents sarin and soman, the reagent is monoethanolamine (MEA), which breaks the phosphorus-fluorine chemical bond associated with neurotoxicity. Analogously, treatment of the persistent Russian V-agent (R-VX) with a solution of potassium isobutoxide cleaves the phosphorus-sulfur bond in the molecule to produce by-products of much lower toxicity.

The second stage in the process is *bituminization*, or mixing with asphalt, to complete the destruction of the chemical agent and to sequester the neutralization residues in an insoluble matrix suitable for disposal in a waste storage facility. The viscous residue from neutralization of R-VX is heated with bitumen (asphalt) to distill out volatile materials such as isobutyl alcohol. After the mixture cools, it sets to a hard, black mass in which the agent residues are presumably immobilized. Similarly, the residues from neutralization of sarin or soman are heated with a mixture of calcium hydroxide (slaked lime) and bitumen to recover MEA for reuse and to immobilize toxic fluoride residues as insoluble calcium fluoride. As with the bituminized R-VX product, the black solid residue is to be deposited in a waste storage vault.

In July 1992,⁸ the CTR program took its first step toward implementing CW destruction with the signing of an agreement “concerning the safe, secure, and ecologically sound destruction of chemical weapons.”⁹ This agreement outlined plans for cooperative planning of CW destruction and technical aspects of implementing the mutually agreed plans. Up to \$25 million was allocated for these activities. The next two years were spent developing a Comprehensive Implementation Plan, setting up mechanisms for collaboration, and selecting American contractors to implement the US commitments.

In 1994, several significant steps occurred. Bechtel National was selected as the lead contractor in a consortium charged with carrying out the initial phases of the plan. The potential funding was increased to \$55 million, with most of the increment designated to create a central analytical laboratory in Moscow and for delivery of three mobile monitoring laboratories (to be provided by another contractor). Under the 1994 “Plan of Work,” Russian and American experts met several times. At a decisive meeting at Chapaevsk in November 1994, they outlined steps leading to construction of a facility at Shchuchie to demonstrate the demilitarization of Russian weapons containing nerve agents.¹⁰

This plan was much narrower and more focused than the original intentions. It did not deal with the CW stockpiles at other sites, but spelled out a protocol for testing the Russian two-stage destruction technology for nerve agents described above. The tests were to be done cooperatively under the Russian-American Joint Evaluation Program. The 1995 Program Plan¹¹ spelled out two

phases in the laboratory-scale evaluation of the process developed by GosNIIOKhT. In the first phase, American technicians guided by Russian scientists employed the Russian process to destroy 50-gram samples of pure sarin, soman, and VX supplied by the United States. This phase was carried out in mid-1995 in a US Army laboratory at Aberdeen Proving Ground in Maryland. The results of the tests were highly encouraging. Cooperation between Russian and American personnel was excellent, although there were disagreements about the instrumentation used to monitor the laboratory atmosphere.

The second-phase tests took place in October-November 1995 in Russia, at the Saratov Higher Military Engineering School of Chemical Defense. These experiments successfully demonstrated that the Russian two-stage process could achieve a 99.99 percent destruction efficiency with Russian munitions-grade agents, and that the destruction was irreversible, as required by the CWC. The final products were classified Level IV (only "slightly dangerous") in the Russian State Standards.¹² A bilateral peer-review committee composed of experts not directly connected to the program reviewed the results of the first- and second-phase testing. These experts generally concurred with the reported findings and made several recommendations for future work. It was apparent to both the peer-review panel and the test participants that much additional development work would be needed to make the two-stage process suitable for scale-up to "bench-scale" tests and later to the "production-scale" demonstration facility at Shchuchie.

After the successful 1995 tests, 1996 was relatively unproductive in terms of technical progress. It was agreed that the next phase of testing would involve the *optimization* of reaction conditions, such as temperature and reactant ratios. A Joint Project Plan (JPP) for the optimization of the two-stage process was developed in March 1996,¹³ but bilateral approval was delayed until December 1996. Also in late 1996, Parsons Delaware, a large engineering contractor, was selected to lead a consortium for scale-up testing and for design of the Shchuchie facility. Further delays in the optimization program occurred in 1998. American scientists involved in the cooperative research found it difficult to reproduce the Russian synthesis of the reagent used to detoxify the R-VX agent. After the 1995 tests, GosNIIOKhT had reformulated the reagent to reduce its

flammability. When the Americans tried to synthesize the reformulated reagent (designated RD-4M) in their own laboratories, they were unable to prepare samples that met Russian specifications for the material. Trans-Atlantic communications failed to resolve the problem, and eight months elapsed before Russian scientists were allowed to come to the United States to provide a "hands on" consultation. Even when they did arrive, communication problems persisted. It was only when US scientists visited the GosNIIOKhT laboratories and witnessed the Russian synthesis equipment and procedures that they solved the problem. It appears that the Russian recipe for making the reagent was imprecise and needed to be modified to provide a reproducible synthesis. The problem has now been resolved and RD-4M meets American flammability standards.¹⁴

The 10-month delay occasioned by the reagent formulation problem typifies the difficulties that have slowed progress in developing the two-stage destruction process. Major technical development programs commonly experience delays caused by honest differences between scientists and engineers in collaborating organizations. However, the CTR chemical weapons program has had many such problems and delays arising from cultural and language differences. These problems have been aggravated by the diffuse, bi-national management structure of the program, which has made it difficult to resolve technical differences expeditiously.

Further Steps Needed to Demonstrate the Process

The initial laboratory-scale tests, though successful in demonstrating agent destruction, were only small steps toward practical implementation of the Russian CW destruction technology. Developing the process itself may indeed be the simplest part of the overall program. Some key hurdles that lie ahead include:

- Completion of the optimization phase;
- Demonstration of the neutralization process on a small pilot scale;
- Demonstration of the neutralization process at production scale;
- Development and demonstration of equipment to remove agent from munitions and to decontaminate the containers;
- Demonstration that the waste disposal plans are environmentally sound;
- Development and demonstration of monitoring capabilities for CW destruction operations;

- Performance of risk assessments and safety evaluations for the process and the Shchuchie facility; and
- Consultation with the Russian citizens residing nearby, whose lives will be affected by operation of the destruction and disposal facilities.

The scale and cost of these activities will be much greater than for the initial demonstration of the process. The joint evaluation and joint optimization programs have cost \$19 million,¹⁵ but, as is common for major industrial projects, larger-scale testing will cost several times that figure. Engineering laboratory facilities will need to be renovated and equipped for scale-up of the process and for integrated demonstration of the munitions-handling facilities. The administrative complexity of the program is increasing as more subcontractors are employed for these tasks. The current status and plans for the various components of the development program are outlined below.¹⁶

Optimization of agent destruction

This phase of process development is almost complete. Using a highly instrumented one-liter glass reactor, which has been set up at GosNIIOKhT, optimum conditions will be defined for carrying out both the neutralization and bituminization of the Russian nerve agents. For each agent (sarin, soman, R-VX), 21 statistically designed experiments will be conducted to define the effect of reaction temperature, reagent composition, and other process variables. The resulting neutralization products will be bituminized and the resulting "bituminized salt masses" will be sent to the United States for toxicology and leaching studies. Analyses of the neutralization products will be carried out using jointly validated analytical methods.

Process scale-up demonstration

Further process development will involve larger-scale tests of the two-stage process at the CTR laboratory in Saratov using munitions-grade nerve agents. These tests, for which facilities are currently being prepared, will be carried out in "bench-scale" equipment one-hundredth the size of that planned for the demonstration facility in Shchuchie. This scale of operation will evaluate the feasibility of the process better than is possible in laboratory glassware and will provide basic data for designing the Shchuchie facility. The experience gained in operating the bench-scale facility will also be valuable, especially since the reactor's automated control

systems will resemble those planned for the full-scale plant.

Draining and decontamination of munitions

Destroying artillery projectiles like those stored at Shchuchie is a complex task. The Russian projectiles do not contain explosive charges as do American shells, but they are not susceptible to the "reverse assembly" process employed in the CW disposal facilities in the United States. Instead, it is necessary to drill into the projectiles to create holes through which the toxic agent can be removed. The projectile is then tilted and drained. After the CW agent has been removed, the interior of the projectile is rinsed with a decontaminating reagent (MEA for sarin and soman, RD-4M solution for R-VX). Finally, the contaminated metal shell is baked at high temperature to remove residual chemicals so that the metal can be reclaimed by smelting.

Prototypes of the individual components of munitions-handling machines were fabricated in Russia and were tested with dummy munitions at the GosNIIOKhT facility in Moscow in autumn 1998. Although the tests were encouraging, the machines have yet to be tested in the integrated fashion needed for production line operations. A large work area has been cleared at the Moscow facility for such tests, but the conveyors and controls needed to link the machines must be acquired in order to demonstrate the subsystems of a Destruction Process Line (DPL). Such testing, again with mock-up munitions, will provide the basis for design of the full-scale DPL at Shchuchie.

Waste disposal-related testing

Two major technical questions concerning the two-stage process relate to the disposal of the bituminized salt masses (BSMs), which constitute the major solid effluent from the process. One question concerns the likelihood that the nerve agent decomposition products will remain locked in the bitumen if this material comes into contact with moisture. Preliminary leaching studies have been done, but more thorough studies are planned using bituminized waste products generated by the most up-to-date process conditions. The current disposal plan is that bituminized products will be placed in steel drums that will be stored in aboveground vaults. However, residents of the Shchuchie area are concerned that the products may be placed in landfills when and if the MOD assumes responsibility for operating the plant.

A second question concerns the potential toxicity of any materials that may leach out of the bitumen over an extended period of time. This question is receiving much attention. Independent preliminary studies done by GosNIIOKhT, the US Army Center for Health Promotion and Preventive Medicine (CHPPM), and the St. Petersburg Institute of Hygiene, Occupational Pathology and Human Ecology all indicate a low level of acute toxicity of the BSM solids. The toxicity is rated Level IV (lowest toxicity) by Russian State Standards, the same level as that of process reagents such as MEA. Studies of subchronic and chronic toxicity are in progress at St. Petersburg. These studies include an assessment of toxicity to the reproductive and immune systems.

Monitoring capabilities

Monitoring of all effluents from the Shchuchie facility is important to protect the health of plant workers, local residents, and the environment as well as to meet Russia's stringent air and water control regulations. The Russian standards for off-site air quality (Populated Area Maximum Allowable Concentrations) are more stringent than the US general population limits for exposure. Indeed, the allowable concentrations are so low that they cannot be measured with any existing monitors. The MOD plans to meet this challenge by measuring emissions on-site and then using computational models of atmospheric dispersion to evaluate concentrations at locations off-site. It remains to be seen whether this approach will prove satisfactory to local residents and government regulators.

Disposal of contaminated waste water from the Shchuchie facility raises the possibility of contaminating the ground water in the area around the plant. Nominally, the two-stage process does not produce aqueous wastes that would be discharged off-site. However, aqueous wastes from the process vent scrubbers, from decontaminating solutions, and from site run-off could be sources of water contamination. The facility is being designed to allow containment, treatment, and monitoring of these effluents.

The CTR program has made a major commitment to developing essential monitoring and analytical technology by funding a Central Analytical Laboratory (CAL) at GosNIIOKhT in Moscow. The CAL has up-to-date instrumentation like that in the US Army Materiel Command's treaty laboratory at Aberdeen Proving Grounds in Maryland. The CAL will be a major resource

to develop and supply analytical capability not just for the Shchuchie development but for other Russian CW stockpile sites.

A December 1996 Russian government resolution provided guidelines for accepting US assistance to build the CAL.¹⁷ Russia's contribution was mostly in-kind, such as office space and personnel. The CAL was essentially a turnkey project, with the United States providing all the money for refurbishing the office space and providing state-of-the-art equipment. Perhaps for this reason, the project was implemented relatively smoothly and was not affected by the August 1998 economic crisis. An added advantage of the CAL project is that it contributes significantly to transparency: GosNIIOKhT has gone from being off-limits to all but a few Russian specialists to become the home of many foreign contractors and experts.

Russian participants see this as one of the most successful aspects of scientific cooperation. Thus, Dr. Victor Petrunin, the director of GosNIIOKhT, is one of a very few Russian officials who are unequivocally positive about the experience of bilateral cooperation. In early 1999, Petrunin predicted the completion of the construction and installation stage of the Laboratory by the end of the year. He was concerned, however, that CTR funding and the presence of the US personnel might be phased out shortly thereafter, before the Laboratory has been fully integrated with Russia's CW destruction facilities and adequately tested in conjunction with full-scale chemdemil operations. Petrunin praised the spirit of cooperation and trust as it evolved throughout the implementation of this project. He pointed out that cooperation on the project was a two-way street, in that Russia shared with US experts valuable information on non-incineration methods of CW destruction, development of which had been mandated by the US Congress.¹⁸

Three US-provided mobile analytical laboratories, which can be moved from site to site to monitor chemical agent emissions, complement the capabilities of the CAL. The analytical laboratories will also provide equipment and expertise to help Russia meet its obligations under the CWC.

Risk assessment

Green Cross Russia, a non-governmental environmental organization, is sponsoring an independent evaluation of risks involved in CW destruction opera-

tions at Shchuchie using the two-stage process. Professor V. M. Kolodkin of the Udmurt State University, who previously analyzed the risks of agent storage at Shchuchie and other Russian stockpile sites,¹⁹ is conducting the operational assessment. The risk assessment is a standard procedure in American chemdemil planning. It is also a necessary step in gaining Russian federal and regional approval of the destruction plan and is an asset in terms of reassuring the local population about the safety of the proposed CW destruction operations.

Public involvement

The CTR program has engaged the Green Cross organizations of Switzerland and Russia to handle various aspects of public outreach for the Shchuchie facility. These activities have included establishing public outreach offices in Kurgan and holding public hearings in the area. The aim of the hearings is to inform the public about ongoing plans for the Shchuchie CW destruction facility and to seek public input about issues related to its construction and operation. Green Cross has conducted similar hearings at other CW storage sites. Funding has been approved for creation at Shchuchie of a Citizens' Advisory Commission like those at US chemical weapons stockpile sites, but the members of the commission have not yet been appointed.

The needs for risk assessment and public involvement reflect the fact that progress on CW destruction depends not only on technical advances but also on political acceptance and support. We have found that cooperation between Russian and American parties has been good at the scientific level, but in the relevant political arenas making progress has been more difficult.

POLITICAL AND DIPLOMATIC PITFALLS

The past record of US-Soviet interactions on chemical weapons had its ups and downs. American officials suspected that Russia was scheming to retain secret inventories of chemical weapons or was clandestinely developing novel chemical warfare agents. One of the latest revelations came from Uzbekistan, where a CTR project was launched in 1999 to dismantle a former Soviet CW development and testing facility near the city of Nukus. Preliminary reports indicated that Nukus was the site where the Soviet military allegedly experimented with binary (Novichok) agents and perhaps produced them in limited quantities. Yet, Soviet and later Russian officials have vehemently denied that the Soviet CW

program had a binary component. Lack of mutual trust made the bilateral working environment much more difficult.

Nuclear cooperation under CTR produced some early success stories. However, these resulted primarily from focus on individual, often unrelated, components rather than from a systemic approach. Since appropriate nuclear procedures had long been in place in Russia and supervisory personnel operated under a clearly defined chain of command, patching emerging gaps was easier to accomplish. The US-Russian commonality in nuclear technologies and culture helped in some cases to overcome organizational and other obstacles that arose during the pioneering effort.

In contrast, cooperation on CW destruction was supposed to proceed quite differently. It was conceived by the US side as a systemic approach because the disorganized Russian executive branch had yet to come up with a meaningful long-term national program. The United States was relatively well advanced in its national CW chemdemil program and was moving, though not without serious domestic glitches, toward the implementation stage. The July 1992 bilateral agreement included a US proposal to participate in developing an overall destruction plan for Russia. But the Russian side angrily rejected this proposal on the grounds that Russia's CW community could adequately do the job itself.²⁰

Russia was still struggling to grasp the scope of the overall problem and its implications. The decisionmaking process was characterized by inter-agency wrangling and lack of leadership. The Presidential Committee for Convention-Related Problems of Chemical and Biological Weapons was established in 1992 with a far-reaching mandate. It acted for some time as the lead agency for chemdemil within the Russian government, mostly because of the personal stature of its chairman, Gen. Anatoliy Kuntsevich (Ret.), who was well connected with the Office of the President and MOD top brass. After Kuntsevich was fired in 1994, the MOD dominated the scene and even backed off from some previously agreed-upon arrangements in the CTR framework. For example, the second-phase tests of the Russian two-stage destruction technology for nerve agents encountered difficulties when requests by the Presidential Committee for visas for US observers ceased to be honored. Further, the Presidential Committee was caught unaware when the tests were scheduled

at Saratov rather than at the GosNIIOKhT laboratories in Moscow. The choice of Saratov was justified on the grounds that munitions-grade samples of the Russian nerve agents were available there. Questions were also raised about the safety of doing large-scale experiments with these highly toxic materials in the Moscow laboratories. Carrying out the experiments in Saratov, however, incurred much added expense for the CTR program. A suite of laboratories in the Saratov school of chemical defense was completely renovated to bring workplace conditions and instrumentation up to American standards. In addition, a sanitarium was leased to provide accommodations for American and GosNIIOKhT personnel who were involved in the second-phase tests.

These interagency bottlenecks and poorly coordinated decisionmaking processes impeded the predictability and accountability of the chemdemil program. In October 1997, the Duma's Auditing Board completed an investigation of the chemdemil program, revealing a number of improprieties. For example, the MOD had spent more than \$1 million out of the meager chemdemil budget on facilities and services not directly relevant to the program. About \$100,000 had been wasted on an R&D project that in no way contributed to the development of environmentally safe destruction technologies. Foreign financial assistance was largely unaccountable, as the Presidential Committee and the MOD provided different estimates. Regarding the US-funded Central Analytical Laboratory project, the estimate by the Economics Ministry of the money received and spent on the project was eight times lower than that of the MOD, which is still the prime procurer under the Federal Program.²¹

With the Russian military calling the shots, Russia further delayed submissions of data required under the Wyoming MOU and was not responsive to US efforts to accelerate the entry into force of the Bilateral Destruction Agreement. This continued reluctance to cooperate fully on US terms complicated the ability of the US Department of Defense (DOD) to allocate funds for Russian chemdemil efforts. The US Congress linked chemdemil assistance to Russia to, among other things, Moscow's compliance with bilateral CW agreements and other arms control treaties.

Under the provisions of CTR Program funding throughout this period, any release of chemdemil money was conditioned on several limitations. The US president was (and still is) required to submit to Congress a

written certification that: (1) Russia is making reasonable progress toward implementation of the BDA; (2) the United States and Russia have made substantial progress toward the resolution, to the satisfaction of the United States, of outstanding compliance issues under the Wyoming MOU and the BDA; and (3) Russia has fully and accurately declared all information regarding its unitary and binary chemical weapons, chemical weapons facilities, and other CW-related facilities.²² These conditions made it more complicated for the US government to plan CTR chemdemil projects on a predictable long-term funding basis. Russian officials often complained that it was impossible for them to factor in US assistance because of the "politically motivated interpretation of Russia's behavior in these areas." Moreover, in the view of the Russian government, the two bilateral agreements with the United States lost much of their relevance after Russia's ratification of CWC and membership in the Organization for the Prohibition of Chemical Weapons.²³

As far as actual implementation, it took some time for the Pentagon and its contractors to adjust themselves to a new mode of relationship with their Russian counterparts. Their original assumption that Russia's organizational and technological approach to chemdemil should eventually be a mirror image of the US experience was not working. Gradually the US government realized that it was dealing with a country in a painful state of transition and nation-building. Hence, to achieve at least some of its original objectives, US chemdemil assistance had to be more flexible and show a spirit of compromise.

SHIFTING TO A HIGHER GEAR

In March 1996, the Russian government finally approved a program to destroy its CW stockpiles, thus providing a much-needed basis for outside chemdemil assistance.²⁴ Under this program, CW destruction was to take place near storage facilities, involving minimal transportation, and was to be completed by 2005. By 2009, all CW destruction and storage facilities would be decommissioned. Under the distribution of roles and missions, the Ministry of Defense was designated as the lead agency for developing and implementing the federal program for phased destruction of the CW stockpiles. The MOD was also assigned responsibility for selecting optimal CW destruction technologies, designing and building destruction facilities and providing so-

cial and medical infrastructure in areas where the facilities were located, and operating the facilities.

Under the Federal Program, the first stage of CW destruction focused on sites in Kambarka and Gornyi, where blister agents are stored in bulk. The remaining sites, containing weaponized agents, fell under the second stage. This approach made sense. The stockpiles in Kambarka and Gornyi represent a greater environmental and public hazard than do the others. At these sites, blister agents are stored in large containers, which are deteriorating and cannot be contained or managed as well as shells and projectiles. Successful CW destruction at Kambarka and Gornyi—once achieved—will provide Russia with the proper stage from which to move into the more complex technical challenges at the other five sites.

What was particularly important was that the Federal Program formally defined Russia's approach to and expectations of international assistance in this area. It involved, among other things, international financial support for CW destruction in Russia, use of other countries' experience in the chemdemil area, and encouragement of a better international climate in the overall implementation of the CWC. Specifically, the attached list of joint arrangements covered: (1) international evaluation of foreign and national CW destruction technologies, including joint experiments and construction of pilot plants for improving relevant technologies and demonstrating their safety to the public; (2) development, manufacturing, and supply of technological equipment, instruments, and monitoring systems for such pilot plants and CW destruction facilities, as well as supply of equipment for analytical laboratories; (3) development of safety systems for CW storage and destruction facilities; and (4) personnel training for CW destruction facilities and supervising the destruction process.

The legal basis of Russia's chemdemil program was further expanded with the entry into force in May 1997 of the Law on CW Destruction. This federal law, whose drafting and numerous revisions took more than three years to complete, was intended to provide legal guarantees to the population affected, directly or indirectly, by CW destruction. Article 26, on international cooperation, gave the provisions of international treaties such as the CWC precedence over Russian federal laws.

During the period immediately after approval of the Federal Program, Russian officials assumed that the

share of outside assistance—both in cash and in kind—would range from 20 to 25 percent of the total cost of destroying the CW stockpile. In absolute terms, foreign assistance would account for roughly \$1 billion out of the original estimate of \$3.7 billion, though this total was later unofficially revised to \$8 billion. Since the level of the chemdemil funding in the Russian budget has lagged hopelessly behind the original schedule, the projected share of international assistance has increased dramatically.

Russian representatives have repeatedly addressed requests for assistance to the European Union (EU) and NATO. In November 1997, during the monthly meeting in Brussels of the joint Russian-NATO Partnership Council of Ambassadors, Russian representatives specifically solicited financial assistance to build all seven CW destruction facilities in Russia specified by the Federal Program. In May 1998, and again in June 1999, current and potential donors committed themselves to providing more assistance. Even under the best case scenario, however, the total amount of what may eventually be donated will not make up for the increasing gaps in domestic funding for the Federal Program.

A CHANGE IN STRATEGY

By the mid-1990s, US-sponsored assistance began to develop a selective and focused approach. The Pentagon made a dramatic shift in emphasis away from the Comprehensive Implementation Plan, which addressed Russia's entire CW demilitarization program, and shifted toward certain key projects. In part, this was a recognition that in the absence of a coherent Russian chemdemil program, available money should be appropriated for individual components without waiting for the Russian side to get its act together.

On the other hand, the reorganization of CTR assistance was an admission that the original expectation of being able to deal constructively with MOD on a wide range of chemdemil issues was an illusion. Colonel General Stanislav Petrov, commander of the Radiological, Chemical, and Biological Protection Troops, was on record criticizing the way the US chemdemil assistance was organized and structured. He contrasted the US system-wide approach with the more limited set of requirements made by Germany, the second largest donor. Petrov definitely preferred the latter approach, which enabled the Russian side to avoid difficult questions and high standards of accountability.

An important manifestation of DOD's new strategy was its emphasis on a project whose sole objective was to construct a pilot CW destruction facility in Russia, while basically ignoring the progress (or lack thereof) of other components of the Federal Program. The city of Shchuchie was designated by MOD as the site where such a facility would be built.

The acceptance of the Shchuchie site was an important compromise by DOD. The two selection criteria originally developed by the United States were (1) maximum reduction of the military threat, and (2) minimum expenditure of time and money. In practice, the United States sought the destruction of air-delivered munitions carrying persistent nerve agents at a site requiring minimal investments in infrastructure. The Shchuchie site, which stored artillery rounds with mostly non-persistent nerve agents, in no way met these criteria. According to Harold Smith, assistant to the secretary of defense for nuclear, chemical, and biological defense programs and the US official in charge of the CTR-CW program until January 1998, Russia's selection of Shchuchie as the site for CTR funding was "a deep frustration to US officials." Nevertheless, Smith supported US acceptance of Shchuchie because "the principal US objective was not to tell Russia what technology to use or where to apply it; the goal was to begin the destruction of the world's largest arsenal of chemical weapons, and that had been accomplished."²⁵

Again in hindsight, it appears that the working environment for any other CW storage site would probably have been even worse, impeding any conceivable progress. For example, the Pochep community in Bryansk oblast is still largely opposed to a CW destruction facility. That is hardly surprising because the entire area was heavily affected by the Chernobyl nuclear disaster in neighboring Ukraine. Similarly, at another potential CW destruction site at Leonidovka in Penza oblast, revelations about the environmentally unsafe destruction there in the 1950s of leaking CW munitions containing over 2,000 tons of mustard, lewisite, phosgene, and other agents had a negative impact on public opinion. During surveys of the area adjacent to the Leonidovka storage site, government experts and NGOs discovered unacceptably high concentrations of dioxins and other contaminants.²⁶ The resulting tense emotional situation and public demands for environmental remediation were hardly conducive to the quick start of any major CTR project.

In the framework of the Shchuchie project, the United States was assigned the task of construction within the industrial zone and the supporting industrial infrastructure outside the zone, including the disposal site for bituminized waste. Russia assumed responsibility for all aspects of the social infrastructure, including the industrial infrastructure supporting the general community around the site. The cost estimate for the US share of the project was put at about \$750 million, including development costs.

DOD conditioned its assistance for the pilot facility construction on Russia's completion of the social and industrial infrastructure, including housing, gas and water lines, storm sewers, and a rail line from the storage site to the destruction facility. The Russian share of project costs is estimated to total \$240 million. In addition, Russia would be responsible for expanding the pilot facility (which will have a capacity of 500 metric tons a year) into a full-scale facility capable of destroying 1,200 metric tons annually. The project has fallen behind schedule by about 14 months, largely because of Russia's delays in completing the facility's conceptual design and because of constraints on US funding.

Despite delays and difficulties of mutual adjustment, in addition to those of a more substantive nature, the Shchuchie project has moved haltingly forward. By the fall of 1998, a location had been chosen and commemorated with a 10-foot monument. Both the MOD and the US contractor, Parsons Delaware, Inc., have been cooperating with Green Cross Russia, an NGO heavily involved in the chemdemil efforts. CTR money has partially funded the establishment of Green Cross information centers in Shchuchie and in Kurgan, the capital of Kurgan oblast.

Kurgan oblast authorities have become increasingly important players, reflecting the shift of power away from the Russian federal government to the regional elite. Regional leaders now play a key role in political movements and associations that are likely to dominate the forthcoming parliamentary elections. The implication for the chemdemil assistance is two-fold. Regions may wish in the long run to bypass the earlier established channels of communication and develop a direct dialogue with foreign donors and their representatives, despite objections by the federal authorities. Secondly, the regions may be tempted to use their newly acquired clout to revise or adjust earlier chemdemil-related pro-

cedures and regulations that, in their judgment, adversely affect their interests.

All six regions where CW stockpiles are stored have formed a group (chaired by Oleg Bogomolov, the governor of Kurgan oblast) whose primary function is to coordinate their bargaining positions vis-a-vis the federal government. Although the US contractor and DOD maintain regular contacts with the oblast authorities, this channel must be further institutionalized to reflect the growing political influence of Russia's regions. Governor Bogomolov was among those who in 1997 pressured the State Duma to ratify the CWC. In his letter to the chairman of the Duma Committee for Foreign Affairs, he stressed, among other things, that "further international assistance to Russia's chemdemil program depends on its joining the Convention."²⁷

Though affiliated with the Russian communist party, Bogomolov is generally positive about US chemdemil assistance and has urged the Russian government to invest its scarce resources in the projects underwritten by the CTR program rather than dispersing the money on other components of the Federal Program. He suggests that the responsibility for building the social infrastructure must be transferred from MOD to the regions, which are better positioned to know their needs and how to deal with them. Bogomolov's endorsement of the Shchuchie project is conditioned on progress in developing social infrastructure projects for the city before work begins on the industrial zone. His other demands include monitoring of the CW destruction process by international organizations and experts, and getting the neighboring Chelyabinsk oblast (which has been severely affected by nuclear accidents) involved in chemdemil decisionmaking.²⁸

Another major hurdle to implementation of Russia's chemdemil program in all regions is the fact that its legal basis has serious gaps. For several years, the Duma and the government have been locked in debate over two competing approaches to the draft law, "On Social Protection of Persons Involved in Work with Chemical Weapons," which is a key to gaining consent from the regions. One approach was proposed by the Chuvash Republic, where chemical weapons were produced in the past; the other approach was developed by the Russian government. The Chuvash draft would provide compensation not only for those whose health is damaged by ongoing or future CW-related operations, but also to those who were harmed by being directly involved

in hazardous production activity. The Russian government opposes the Chuvash approach on the grounds that it would set a precedent that could enable former employees of other (non-CW) defense facilities, where safety was also sacrificed for the sake of increased production quotes, to claim compensation as well.²⁹

Another draft law rejected by the Federation Council would regulate compensatory payments for emergencies that occur during the storage, transport, and destruction of chemical weapons. Among other legal acts yet to be initiated or finalized are the introduction of a licensing system for CW destruction and amendments to the administrative and tax codes. Until the draft laws have been developed to the satisfaction of the affected regions, cooperation with local communities will remain shaky.

The August 1998 economic crisis in Russia and the ensuing devaluation of the ruble delivered a devastating blow to the Federal Program, which had been conceived and finalized only two years before. Russia's total federal budget in 1999 shrank to \$20 billion, with a defense component of less than \$4 billion. Despite continuous financial hardships in the past, the major players in the chemdemil efforts were not prepared for this shock and entertained the illusion that the economic problems were mostly temporary. They expected that immediately after Russia ratified the CWC, the industrialized countries would live up to their "moral obligation" to provide Russia with full-scope assistance for the chemdemil program.

Against the backdrop of continued political instability, government reshuffling, and uncertain prospects for the parliamentary and presidential elections, it is evident that previous assumptions about the relationship between Western donors and Russia require drastic rethinking. At the very least, a notion of a cooperative approach to reducing threats that implies equal partnership and joint responsibility no longer captures the emerging reality. Moreover, the concept that served as the original basis for the CTR assistance program—that of providing a one-time "jump-start" for Russia's chemdemil program, after which Moscow would take over the entire effort—has been overtaken by events.

IMPACT OF THE AUGUST 1998 CRISIS

The Russian Federal CW Destruction Program is now at least four years behind its original schedule. A major

reason continues to be budgetary underfunding, as admitted by Colonel General Stanislav Petrov, commander of the Radiation, Chemical, and Biological Protection Troops. In 1996, only 1.3 percent of the amount requested for chemdemil in the Russian federal budget was actually appropriated; in 1997, this share rose only to 2.2 percent; and in 1998 it increased to 3.9 percent.³⁰ Under the Federal Program, the years 1998 and 1999 were supposed to be the peak period for investment in the construction of the CW destruction facilities. The Gornyi facility was scheduled to begin operation in 1999, yet it was not until March that the project received an environmental assessment approval, still part of the blueprint development stage. Even if Gornyi is completed to become the first CW destruction facility in Russia, it is primarily a demonstration facility and will eliminate only 2.9 percent of the stockpile.

A week after the Federal CW Destruction Program was adopted, it was given the status of a presidential program, which at that time meant a higher priority in terms of national interest and funding. As of 1998, there were a total of 27 presidential programs whose actual funding averaged 35 to 45 percent of the minimal required level. (These projects include housing construction for the Russian military, benefits for those who move out of extreme Northern areas on completion of their contracts, financial support for specially gifted university students, and so forth.) To fund all existing presidential programs would require about \$1.8 billion, which is completely unrealistic given the size of Russia's total budget.³¹ Even so, the fact that the Federal Program for CW destruction has been funded at a much lower rate than other presidential programs should provide food for thought. For Russia's leaders, providing vital services to the military during the resumption of hostilities in the Caucasus and prior to the turbulent elections in the year 2000, in particular, may take priority over destroying the CW stockpile.

According to General Petrov, the shortage of money in the federal budget has already taken its toll on the MOD's contractual system. The MOD currently owes its contractors over \$5 million, and its continued inability to pay its debts has seriously undermined its credibility and stature. A major bottleneck in the Russian chemdemil program is that by law, social infrastructure projects must be well under way before a CW destruction facility can be built. Social infrastructure for local communities implies basic services such as gas pipe-

lines, water filtration, and sewage, which are still lacking in areas where the destruction facilities are planned. Traditionally, the location of CW storage sites was a state secret, and the military discouraged any economic or other improvement projects that might jeopardize secrecy and increase the local population. Now that the regional authorities and local communities have become important players, however, they demand socioeconomic improvements as a quid pro quo for accepting the risks and burdens of CW destruction.

Approval of government resolution No. 402 of April 17, 1998, which authorizes the start of social infrastructure projects before the feasibility studies for CW destruction facilities have been completed (e.g., by relying on working blueprints and estimates), has given the MOD some legal room for maneuver.³² Without adequate funding, however, the MOD's accomplishments to date have been limited. In Gornyi, the MOD has completed an 18-apartment residential building and a five-mile long high-voltage transmission line (half of the total requirement), but the sewage lines, water supply, and other related facilities are still under construction.³³ Comparable progress has been made in Kambarka, but in Shchuchie there are no signs of a breakthrough apart from preliminary work on housing for construction workers.

Frequent restructuring of the Russian federal government has made the management of the chemdemil program even less effective. Several legal documents define the distribution of departmental roles and interagency decisionmaking, but these laws have often been ignored in the quest for influence and money, or have been made irrelevant by the reshuffling of departments and agencies. In late May 1999, the Presidential Committee was abolished and its staff was integrated into a new federal government agency for munitions, which was also designated as the National Authority under the CWC.

The demise of the Presidential Committee was mostly the result of its tug-of-war with the MOD over the control of Russia's chemdemil efforts. MOD leaders had publicly recommended abolishing the Presidential Committee, which had hoped to be designated the Russian National Authority; the MOD wanted to assign these functions instead to its Nuclear Risk Reduction Center. Nevertheless, some observers are critical of the way MOD has handled its tasks as the main procurer and operator for the chemdemil program. They predict that as the program moves ahead, the MOD will lack the required expertise and skills to manage such a sensitive

high-tech program. Indeed, some signs suggest that the MOD leadership is looking into the option of sharing responsibility for chemdemil activities with industry or even phasing out its involvement completely (except for retaining control over CW storage facilities).³⁴

LOSS OF SUPPORT IN THE US CONGRESS AND ITS IMPLICATIONS

Against this bleak background, it is hardly surprising that the perception of chemdemil assistance to Russia as an expendable program has resurfaced in the US Congress. This perception is based on the premise that Russia's CW stockpiles pose no real threat to US national security, and that instead of keeping the Russian chemdemil effort afloat, it is preferable to upgrade the security of the CW storage facilities as a precautionary measure against possible terrorist attacks.

Contributing to this emerging view was an April 1999 report by the US General Accounting Office (the investigative agency of Congress) titled *Efforts to Reduce Russian Arsenals May Cost More, Achieve Less Than Planned*. According to this report, the United States lacks assurance that the Shchuchie project will achieve its broader national security objectives of accelerating the destruction of CW at other depots and helping Russia comply with its CWC obligations.³⁵ On August 6, 1999, a House-Senate conference committee voted to eliminate all \$125 million slated for the Shchuchie project and to reallocate \$20 million to enhance security at Russian CW storage sites. The decision was based largely on the premise that chemical weapons pose more of an environmental threat to Russia than a security threat to the United States.

The notion that Russia's CW stockpile poses no threat to US security is fallacious. Russian chemical munitions are in good condition, have tremendous agent dispersal ability, and are as capable now as when they were produced. According to CTR Director Thomas Kuenning, Russian chemical munitions are man-carryable and could be easily stolen by terrorists, who would then have access to pounds or more of deadly agents. Moreover, some CW warheads can readily be placed on SCUD-type missiles, which are owned by many countries.³⁶

At this juncture, Russia's chemdemil efforts may follow one of two dangerous paths:

- (1) *Status quo*. In this scenario, the Russian Federal Program would not undergo any drastic changes. If

the program continues to lack internal funding and effective management, foreign donors will be reluctant to provide anything but symbolic assistance, and Russia's expectation of raising money from international financial institutions is unlikely to materialize. The entire program would slow down and a number of projects that have begun would remain uncompleted. Chronic lack of funds may result in attempts to cut corners, in particular, to employ cheaper but not necessarily safer CW destruction technologies.

- (2) *Withdrawal from the CWC or a moratorium on its implementation*. In June 1999, the State Duma adopted a resolution "On the Unsatisfactory Implementation by Russia of the Chemical Weapons Convention." The thrust of this resolution is to set up a commission that would look into Russia's record of complying with its CWC obligations and destroying its chemical stockpiles in an environmentally sound way. The underlying assumption is that Russia was and is unprepared financially and technologically to assume these obligations. The resolution implies that the two-stage method should be reevaluated and thoroughly tested before being approved for industrial-scale use. Most supporters of this resolution would prefer a moratorium on Russian CWC implementation or even withdrawal from the Convention.

Neither of these scenarios would meet US or international security interests. Further delays in Russia's CW destruction will inevitably challenge the letter and the spirit of the CWC, while Russian withdrawal from the Convention would undermine its universality and damage the CW nonproliferation regime.

FINDINGS AND RECOMMENDATIONS

Russia's chemdemil program based on the two-stage destruction process is faced with economic and political rather than technical problems. Technological development is making slow but significant progress toward the goal of an operational destruction facility at Shchuchie, but inadequate Russian funding and management problems seem likely to cause major and unpredictable delays.

Laboratory-scale studies have successfully demonstrated that the Russian two-stage chemical agent destruction process can effectively destroy the major nerve agents in the Russian arsenal. Preparation for larger-scale testing is proceeding well. Although the results to

date are encouraging, concerns still exist, particularly with respect to the efficacy of bituminization and the safe disposal of the solid waste that results from the process.

A critical issue is public acceptance that the two-stage technology is safe and will not harm public health and the environment. Community understanding and acceptance of the environmental aspects of the two-stage process will be essential for its successful implementation at the Shchuchie facility. While positive steps have been taken to inform the local residents about the CTR plans, it is not clear that acceptance is assured. Some local residents seem satisfied with the safety of the first stage (detoxification of nerve agents), but their confidence in the environmental safety of the second stage (bituminization) is lower. The major concern is that the agent neutralization products will not be effectively locked into the bitumen or that the bituminized products will be disposed of in a way that permits toxic materials to leach out into the groundwater. The CTR management needs to recognize and address this perceived hazard, as well as other concerns that may be present in the community.

One problem in gaining public acceptance is that the people living near the proposed destruction site have a low degree of confidence in the MOD and other federal institutions. The US government should work with other Western donors and NGOs to facilitate citizen input on CW disposal decisions at all Russian stockpile sites. Establishment of Russian citizen advisory boards analogous to the US Citizens Advisory Commissions could help in this regard, but the concept needs to be adapted to the Russian context.

In addition, the US and Russian governments should establish an international panel of respected scientific and public figures to evaluate contentious aspects of the CW destruction program and make recommendations for resolution of these problems. The US National Academy of Sciences and the Russian Academy of Sciences should co-sponsor the panel. The US National Research Council could supply experienced staff to help organize the panel and facilitate its work.

Donor countries must meet the overall challenge of keeping the Russian program afloat by pooling their efforts, developing a joint funding methodology, and coordinating their national priorities. Speaking with one voice to the Russian government, encouraging a repre-

sentative and authoritative mix of Russian counterparts to negotiate with, and urging maximum transparency and responsiveness will be vital prerequisites of future success in eliminating this toxic legacy of the Cold War. The optimal approach would be to concentrate on one or two destruction facilities and to complete their infrastructure on a turnkey basis. As the first priority, the best option would be to start with all efforts concentrated on the Shchuchie project. In addition to committing itself to building the pilot plant, the United States may consider the option of extending its commitment to the scaled-up facility. Rapid success in completing the Shchuchie facility and putting it into operation would provide a much-needed proof of achievement and a visible push toward Russia's compliance with its CWC obligations. A smoothly and safely operating facility would send an encouraging signal to other stockpile sites and perhaps accelerate the activity there. If foreign donors (other than the United States) continue to invest in different sites, as MOD evidently would like them to do, the dispersal of assistance (in the absence of matching contributions from Russia) could have a series of negative consequences. Long delays in the original construction schedules would discredit the idea of assistance, reduce support for the program by the local constituencies in donor countries, and doom the unfinished facilities to obsolete technologies.

In the meantime, the Russian government must concentrate on the Gornyi and Kambarka sites, as they are the most hazardous, but least technologically challenging, of the seven storage facilities. At the other four sites, international assistance would focus for the time being on enhancing the security and safety of CW storage. Increased Western assistance at Shchuchie would not be unconditional. In return, the West could demand that the entire Russian federal plan for chemical demilitarization be dramatically revised.

The next phase could be based on revisiting the concept of transporting chemical weapons either to Shchuchie or to a revived destruction facility at Chapayevsk or to some other regional destruction facility. Russia should face the hard reality of continued lack of money for full-scale destruction at all CW storage sites. Foreign assistance would be concentrated, jointly with Russia, on developing the means for safe transportation of chemical munitions to a few centralized destruction facilities. Dedicated transport routes would be designed and built so that they could be easily converted

into modern highways or railway systems for public transport after the CW destruction program has been completed, or even during its implementation. The affected Russian regions may accept this approach because they would benefit from this new infrastructure after the chemical weapons are gone.

While in the mid-1990s, flexibility and compromise solutions in the CTR framework were generating much-needed momentum in the area of chemdemil, the current stage requires a proactive and resolute strategy. A wait-and-see approach risks creating a situation completely opposed to what the Nunn-Lugar program stands for. This proposed strategy, instead, runs counter to the current US “jump-start” approach by placing much more of the burden of Russian chemdemil on the United States and other donors. It must be recognized that in the prevailing economic and political environment in Russia, previous assumptions are becoming increasingly obsolete. Reluctance to restructure the assistance programs in coordination with Russia’s efforts to realistically revise its Federal Program may lead to much higher costs in the future.

⁷ V. A. Petrunin, “Principal Approaches to the Synthesis of Chemical and Technological Systems for CW Destruction,” document submitted for discussions concerning implementation of the Russian-American Joint Evaluation Program, Moscow, 1994.

⁸ I. Khripunov, “US Assistance to Russia’s Chemical Demilitarization Efforts,” in J. M. Shields and W. C. Potter, eds., *Dismantling the Cold War: US and NIS Perspectives on the Nunn-Lugar Cooperative Threat Reduction Program* (Cambridge, Mass.: MIT Press, 1997), pp. 363-382.

⁹ *Agreement between the United States of America and the Russian Federation Concerning the Safe and Secure Transport, Storage and Destruction of Weapons and the Prevention of Weapons Proliferation*, dated June 17, 1992, was the umbrella agreement, which was followed by *Agreement between the Department of Defense of the United States of America and the President’s Committee on Conventional Problems of Chemical and Biological Weapons of the Russian Federation Concerning the Safe, Secure, and Ecologically Sound Destruction of Chemical Weapons*, dated July 30, 1992.

¹⁰ *Addendum to Paragraph 12 of the 1994 Plan of Work for Assistance to the Russian Program for the Destruction of Chemical Weapons within the Framework of the Bilateral Destruction Agreement*, dated November 16, 1994.

¹¹ *Program Plan for the Russian-American Experiment on the Joint Evaluation of the Two-Stage Destruction Process of Organophosphorus Reagents*, dated February 17, 1995.

¹² K. J. Flamm and N. A. Pakhomov (approvers), “Joint Evaluation of the Two-Stage Chemical Agent Destruction Process: Final Joint Evaluation Technical Report,” Support Contract, DNA 001-95-C-0058, Bechtel National, Inc. Job No. 22911, issued March 8, 1996; revised version issued July 1996 (bilingual text).

¹³ E. Konovalov and P. Nelson (approvers), “Joint Project Plan for Optimizing the Two-Step Destruction Process to Support the Russian Chemical Weapons Destruction Program within the Framework of the Bilateral Agreement of 30 July 1992 and the Implementing Arrangement of 17 July 1996,” November 22 draft approved December 11, 1996.

¹⁴ General Accounting Office, “Weapons of Mass Destruction: Effort to Reduce Russian Arsenals May Cost More, Achieve Less Than Planned” (Washington, DC: GAO/NSAID 99-76, 1999), p. 12.

¹⁵ Kevin Duvall, Task Manager, Joint Optimization and Process Scale-up Projects, US Army, July 28, 1999.

¹⁶ US Army, In-Process Review, “Russian CW Destruction Support Program,” Edgewood, MD, April 14-15, 1999.

¹⁷ “On the Establishment of a Central Chemical Analytical Laboratory for Monitoring Work in the Area of Chemical Disarmament,” Government resolution No. 1447, December 7, 1996, *Rossiiskaya Gazeta*, December 19, 1996.

¹⁸ Interview with Victor Petrunin, Director of the State Research Institute of Organic Chemistry and Technology, Moscow, January 29, 1999.

¹⁹ V. M. Kolodkin, “Risk Assessments of the potential hazard connected with storage facilities for chemical warfare agents (Kambarka, Kizner, and Shchuchie Arsenals),” Udmurt State University, Izhevsk, Russia, 1998.

²⁰ Khripunov, “US Assistance to Russia’s Chemical Demilitarization Efforts,” pp. 374-375.

²¹ “Memorandum by S. Sulakshin, Deputy Chairman of Duma’s Committee on Industry, Construction, Transport and Energy, dated October 30, 1997.

²² Strom Thurmond National Defense Authorization Act for FY 1999, Public Law 105-261, <<http://www.stimson.org/cwc/ctr99.htm>>.

²³ Interview with Alexander Ivanov, Acting Chairman of the Presidential Committee on Conventional CW and BW Matters, Moscow, February 1, 1999.

²⁴ “Federal Program of the Destruction of RF CW Stockpiles.”

²⁵ Harold Smith, “Funding CW Demilitarization in Russia: Time to Share the Burden,” *Arms Control Today* 28 (November/December 1998), pp. 18-19.

²⁶ “Surveillance of the Former Chemical Weapons Destruction Facility in the Penza Region,” Green Cross International, <<http://www4.gve.ch/gci/GreenCrossPrograms/legacy/Chemtrust/penza/penza1.html>>.

²⁷ Letter by Governor Oleg Bogomolov to Vladimir Lukin, Chairman of the Duma Committee for Foreign Affairs dated October 14, 1997 and registered

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² Ashton Carter and William Perry, *Preventive Defense: A New Security Strategy for America* (Washington, DC: Brookings Institution Press, 1999), pp. 70-72.

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⁶ “Federal Program of the Destruction of RF CW Stockpiles,” Government resolution No. 305 of March 21, 1996, *Rossiiskaya Gazeta*, April 2, 1996.

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²⁹ *Problemy Khimicheskoi Bezopasnosti*, Report UCS-INFO. 349, December 7, 1998.

³⁰ Interview with Colonel General Stanislav Petrov, *Yadernyi Kontrol*, March-April 1999.

³¹ Milana Kislyakova, "Presidential Programs Have Been Suspended," *Nezavisimaya Gazeta*, May 13, 1999.

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³³ Interview with Colonel General Stanislav Petrov, *Yadernyi Kontrol*, March-April 1999.

³⁴ Press conference of Duma deputy Tamara Zlotnikova, Academician Anatoly Kuntsevich and Dr. Lev Feodorov, National Press Club, Moscow, June 17, 1999, FNS Transcript (in Russian).

³⁵ United States General Accounting Office, Report to the Chairman and Ranking Minority Member, Committee on Armed Services, House of Representatives, *Weapons of Mass Destruction: Effort to Reduce Russian Arsenals May Cost More, Achieve Less Than Planned*, GAO/NSIAD-99-76, April 1999.

³⁶ *Chem-Bio Weapons and Defense Monitor*, May 31, 1999, p. 3.