VIEWPOINT: ARSENIC AND OLD WEAPONS: CHEMICAL WEAPONS DISPOSAL IN RUSSIA

by Milton E. Blackwood, Jr.

The United States and the Soviet Union during the Cold War stockpiled the world's largest arsenals of chemical weapons. As the Cold War ended, the United States and Russia signed two bilateral agreements, in 1989 and 1990, designed to hasten the destruction of these weapons, and in 1997 both countries ratified the Chemical Weapons Convention (CWC), which bans the use, development, production, stockpiling, and transfer of chemical weapons and requires that signatory states destroy their chemical weapons stockpiles by April 2007. Despite these commitments, both countries are finding that destroying their chemical weapons stockpiles is not an easy task. While the United States disposal program has proven to be extremely costly, there is little doubt that the resources are available to eventually complete this program. In contrast, a lack of adequate funding brings into question whether Russia will be able to meet its disposal requirements even with the five-year extension that a country can request on a one-time basis under the CWC.

Russia signed an agreement in 1992 with most other members of the Commonwealth of Independent States in which it assumed sole responsibility for destroying the former Soviet chemical weapons stockpile of some 40,000 tons of chemical agents. The Russian disposal program has been estimated to cost three to eight billion dollars, and this amount may be optimistic considering the cost increase the United States program has experienced upon going from the planning to the operational stage.[1] The Russian government stated that it would finance its chemical weapons disposal program through federal support and foreign assistance. Government support and foreign assistance, however, are currently at levels well below the billions of dollars the Russian chemical weapons disposal program will cost. Only 14 percent of the money promised to the disposal program from 1995-1997 was delivered by the Russian federal government.[2]

The United States is providing assistance to the Russian disposal program through the Cooperative Threat Reduction (CTR) program, which supports joint programs between the United States and the former Soviet republics to secure and dismantle weapons of mass destruction, prevent weapons proliferation, and demilitarize the former Soviet defense industry. Since 1992, more than one billion dollars has been spent under the CTR, and an additional $425 million was included in the FY1999 appropriation bill. Most of this money has gone to reduce the nuclear threat in states of the former Soviet Union, but the United States has provided $200 million for chemical weapons disposal in Russia. Other nations are providing smaller amounts of funds for the Russian disposal program: Germany, the Netherlands, Finland, and Sweden are supplying some $31 million for the destruction of Russian blister agents, and the European Union has agreed to provide the Russian program with an additional $15 million through 1999. The amounts of money available still fall well short of the billions that the Russian disposal program will require for completion, however.

Russia has claimed that a project designed to recover ultrapure arsenic from its stockpile of the chemical warfare agent lewisite will provide an additional source of funding for its disposal program—a claim that I will argue is unconvincing. In any case, the lack of money is not the only problem that the Russian government faces as it tries to destroy the country's chemical weapons. An equal, if not bigger, problem will be convincing a skeptical Russian population that the disposal program will be conducted in a safe manner. Until these concerns are met, the successful disposal of Russia's chemical weapons cannot be assured regardless of increases in domestic or foreign funding of the disposal program. Fortunately, the configuration and condition of weapons in the Russian chemical stockpile makes them less a proliferation threat than has sometimes been implied.

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Yet the weapons do, without doubt, present threats to their local environments and communities—a condition that foreign assistance could help reduce.

This viewpoint addresses financial and environmental issues related to Russian chemical weapons disposition, in five parts. First, I will describe the size and scope of the Russian chemical weapons stockpile, with a particular emphasis on its environmental and health dangers. Then, I will review past and current strategies and facilities for disposition of this stockpile. Third, the viewpoint will address the possibility of raising funds for the disposition effort by selling arsenic recovered from lewisite; and fourth, considering this as well as other sources of funding, it will lay out the overall prospects for financing the disposition effort. Finally, I argue that local opposition may be as great a barrier to current disposition plans as financial considerations, and that foreign assistance ought to focus more on local environmental threats than on proliferation threats.

RUSSIAN CHEMICAL WEAPONS

In 1987, Soviet President Mikhail Gorbachev announced that, with the closing of nerve agent factories at Novocheboksarsk in Chuvashia, the Soviet Union had halted the production of chemical weapons. The declared Soviet stockpile included approximately 32,200 tons of nerve agents (sarin, soman, and V-agents) and 7,700 tons of blister agents (lewisite, mustard, and mustard/lewisite mixtures) stored at seven sites.[3] The agents exist in a variety of conditions and configurations, with the older blister agents mostly stored in bulk containers and the newer nerve agents stored in artillery and aviation munitions (Table 1). Fortunately, Russian munitions are not loaded with explosives and propellants (known collectively as energetics), which eliminates some of the difficulties with weapons disposal experienced in the United States, where many munitions are fully configured with energetics.

Besides the tons of munitions that must now be destroyed, the Soviet chemical weapons production program produced a legacy of severe environmental and health problems. A 1998 photo essay in *The New York Times Magazine* dubbed the town of Dzerzhinsk, a former site of Russian chemical weapons production, "The Most Tainted Place on Earth."[4] David Hoffman of *The Washington Post* has also reported on the effects of buried and dumped chemical weapons in Russia.[5] Former workers in the Soviet chemical weapons program claim they are suffering from adverse health effects because of the lack of adequate safety measures in the factories, and in communities around these sites citizens suffer from the unsafe production practices and haphazard disposal of waste and unwanted chemical weapons in the past.[6]

At Chapayevsk in the Samara Province, where lewisite and mustard gas were produced, tests performed in 1993-1994 reportedly found arsenic concentrations in the soil around the former plant to be 8,500 times the permissible concentration (two milligrams per kilogram); in areas of the surrounding town, they were two to ten times the permissible concentration.[7] Mental deficiencies and diseases of the central nervous system are reportedly higher among children in Chapayevsk compared to children of other cities in the Samara province.[8] The average arsenic concentration in soil from Leonidovka, where chemical munitions were reportedly buried in the early 1960s, was found to be some 15,000 times the permissible concentration. Burial as a means of disposal

Table 1: Declared Russian Chemical Munitions Storage Sites

SITE	AGENTS	STORAGE	APPROXIMATE TONNAGE
Maradikovsky	VX, Sarin, Soman, Mustard/Lewisite mixture	Weaponized	7760
Leonidovka	VX. Sarin, Soman	Weaponized	6880
Pochep	VX, Sarin, Soman	Weaponized	6720
Kizner	VX, Sarin, Soman, Lewisite	Weaponized	6410
Kambarka	Lewisite	Bulk	6300
Shuchye	VX, Sarin, Soman	Weaponized	5440
Gorny	Mustard, Lewisite, Mustard/Lewisite mixture	Bulk	1160

was not unique to the Soviet Union in past decades. In the United States, as part of its "non-stockpile" chemical disposal program, the United States Army is working to locate and remediate suspected chemical munition burial sites.[9] However, no such program exists in Russia, and the presence of the weapons burial sites is not acknowledged by its government or military.

DISPOSAL EFFORTS

Russia currently lacks the necessary capacity to dispose of its chemical munitions. In previous decades both the United States and the Soviet Union routinely disposed of chemical weapons by open-pit burning, land burial, and sea dumping. The CWC does not stipulate the disposal technology to be used, but these three options are forbidden, and the chosen technology must minimize risk to the health of humans and the environment. Reportedly, between the 1940s and the 1980s, the Soviet government disposed of some 120,000 tons of chemical warfare material by sea dumping (into the Baltic Sea, the Pacific Ocean, the Arctic Ocean, and the White Sea), burning, or burial.[10] Later Soviet and current Russian chemical weapons disposal efforts, as in the United States, have focused on on-site technologies to avoid the problems of transporting chemical weapons.

In 1986, the Soviet government constructed a demonstration destruction facility in Chapayevsk that utilized neutralization and incineration technology. The facility, which was designed to destroy 350 tons of nerve agent yearly utilizing hydrolysis followed by incineration, cost 50 million rubles and took more than three years to build. The plan had been approved by the local authorities but was kept secret from local residents. The public became aware of the project when construction was in its final stages, and an outcry ensued that included rallies, picketing, and petitioning for an end to the project.[11] In 1989, the local council voted against operation of the disposal facility, and the federal government agreed to abandon the facility as a chemical weapons disposal site.

The Chapayevsk decision leaves Russia with only a single mobile facility for the destruction of chemical weapons. This system was designed only for the destruction of damaged and deteriorating chemical munitions, not the general disposal of the Russian chemical weapons stockpile. To win public support for future disposal programs, governmental proposals for future chemical weapons destruction are required to include provisions that improve the social conditions and infrastructure for the areas that surround disposal sites.[12] The plans must also receive local public approval, and President Boris Yeltsin has pledged benefits for former chemical weapons workers and the construction of medical centers near any new chemical weapons disposal facilities.

US assistance for Russian chemical weapons disposal has focused on helping Russia destroy its stockpile of weaponized nerve agents, including a joint evaluation of the two-stage disposal process that the Russians have selected. Russian chemical weapons, unlike US weapons, are welded shut during assembly, prohibiting the "reverse-assembly" process used in the United States in its disposal program. The proposed destruction process for the Russian nerve munitions involves sending them through "drill-and-drain" machines to remove the nerve agent. In the first stage, the drained nerve agent will be chemically neutralized by adding a second chemical reagent that reacts with the nerve agent—monoethanolamine for sarin and soman, and a mixture developed in Russia, called RD4M, for VX. After neutralization, the second stage involves the bituminization of the resulting solution. (In bituminization, the neutralized product is mixed with hot petroleum asphalt.) After solidification, the final product will be sealed in barrels and buried above groundwater level in concrete bunkers located next to the destruction facility. A review committee of three Americans and three Russians concluded that the two-stage technology met, or exceeded, requirements for the irreversible destruction of nerve agents in a manner safe to human health and the environment. The joint evaluation of the two-stage process found that 99.99 percent destruction of the nerve agent was achieved, but some questions remained regarding whether the resulting bitumin mass was safe for disposal in the concrete bunkers.[13]

The Russian Federation Ministry of Defense has chosen Shuchye as the location for the first facility designed for the destruction of nerve-agent-filled munitions. Shuchye, located 975 miles east of Moscow, stores 5,400 tons of nerve agent in nearly two million munitions, representing approximately 14 percent of the total Russian stockpile on an agent tonnage basis. The United States has already provided more than $135 million for the Schuchye facility, and the foundation stone for the plant was laid on September 28, 1998.[14] The governor of the Kurgan Region, however, insisted that the installation

not be built until the concerns of the local population were met. Failure to address community concerns could thus further delay Russian destruction of its CW stockpile.

RECOVERING ARSENIC FROM LEWISITE

Lewisite was first synthesized to provide a less persistent blister agent than mustard agents.[15] Mustard agents, the most common blister agent used during the First World War, had the disadvantage of lingering in the environment, making attacked sites uninhabitable to defender and attacker alike. Dr. W. Lee Lewis synthesized the compound that bears his name at the Catholic University in Washington, DC, in 1918. The design of lewisite was based on the structure of a variety of arsenical agents that had been fielded in Europe by the Germans during World War I. The relatively low solubility and rate of reaction with water made lewisite more persistent than was originally desired, but it was nonetheless produced as a complement to mustard agents. After Dr. Lewis's discovery, large-scale production of the new warfare agent began at the Army Edgewood Arsenal in Maryland, and, at the time of the Armistice, 150 tons of lewisite munitions were on a ship bound from the United States to France. Rather than bring the ship and its cargo back, the Navy sank the vessel at sea.

Lewisite is most commonly manufactured by reacting acetylene with a mixture of arsenic trichloride and aluminum chloride and fractionating the resulting product with hydrogen chloride gas. Between the World Wars, while production of lewisite slowed in the United States, production of the agent spread to other countries including Great Britain, France, the Soviet Union, Italy, and Japan. Lewisite was among the chemical agents that the Japanese used in China during World War II, but other belligerents did not use chemical weapons in World War II and, after the war, many nations were left with stockpiles of unused weapons. Military interest in lewisite and other World War I-era chemical warfare agents was reduced with the realization that Germany had developed more toxic agents, the so-called nerve agents, and produced stockpiles of weapons containing these agents during World War II. In addition, by the end of World War II, British scientists had developed a treatment for lewisite poisoning, designated British Anti-Lewisite (BAL). The United States destroyed nearly all of its stockpile of lewisite by mixing it with sodium hypochlorite and dumping the resulting mixture into the Gulf of Mexico in 1946.

Russia, however, still retains some 8,000 tons of lewisite produced in the former Soviet Union. Approximately 6,300 tons are stored at Kambarka in stonewalled, wooden-roofed buildings that each contain 16 steel tanks of 50 cubic meters, filled to various amounts.[16] Russia has claimed that as much as 2,300 metric tons of metallic arsenic can be obtained from their lewisite stockpile; with prices for semiconductor-grade arsenic between $1,000-2,000 per kilogram, this conversion would appear, on first glance, to provide a significant amount of money for the country's chemical weapons disposal program.[17]

While some have argued that the Russian arsenic recovery plan is viable, others question its value.[18] Most commercial trade of arsenic is in the form of arsenic trioxide, with an estimated 40,600 metric tons produced worldwide in 1997.[19] China is currently the world's largest producer of arsenic products, whereas the United States, which does not produce any arsenic domestically, is the world's largest consumer of arsenic, requiring some 23,700 tons in 1996. The major use of arsenic is in wood preservatives. Around 90 percent of total US demand is for this purpose, in which arsenic trioxide is converted to arsenic acid for the production of the preservative chromated copper arsenate. Other minor uses of arsenic are in the glass industry and in the production of battery alloys. Arsenic is also used in the production of some herbicides, but agricultural uses have decreased in the United States since 1993, when the EPA banned the use of arsenic acid as a cotton desiccant. In 1997 the average price for arsenic trioxide was $0.31 per pound (approximately $680 per metric ton).

Arsenic metal, made by the reduction of arsenic trioxide, represents only three percent of the world's arsenic demand, and the use of high-purity arsenic metal (99.9999 percent pure or greater) in semiconductors is an overall minor use for metallic arsenic. Commercial-grade arsenic metal (99 percent pure) is mainly produced in China, and its 1997 price was approximately $700 per metric ton. At prices between $1,000-2,000 per kilogram, however, a ton of semiconductor-grade arsenic would be worth between one and two million dollars, and the 2,300 tons that some Russians claim can be produced from the lewisite stockpile would appear to be quite valuable.

The first problem with the Russian plan is the size of the world market for highly pure arsenic. Ten companies provide essentially all of the world's demand, and the two largest producers, Furukawa Electric Co. Ltd. in Japan and Preussag AG in Germany, produce annually only 30 and 15 tons, respectively. Clearly, there is no demand for 2,300 tons of highly purified arsenic on the world market at current prices. If, like Furukawa Electric Co., Russia were able to produce 30 tons of ultrapure arsenic a year, it could be sold for $30-60 million. But in reality Russia's lewisite stockpile is even less valuable.

The arsenic recovery technology involves first neutralizing the lewisite with a basic solution and then utilizing a process known as electrolysis to generate metallic arsenic.[20] The metallic arsenic must then be purified to the requirements of semiconductor manufacturing. The purification process is crucial. The lewisite stockpile is only a crude source of arsenic. It will contain not only the impurities present in the original agent, but also impurities introduced as the lewisite and its container have degraded over the years. Crude arsenic costs approximately $800 per ton, which would put the total value of the Russian lewisite at only about $1.6 million.

Though the proposed arsenic recovery project will not provide a source of funds for Russian chemical weapons disposal, the population of Kambarka might find this project attractive for other reasons. Lewisite presents a disposal challenge that the nerve and mustard agents in the Russian stockpile do not—the disposal products of lewisite contain toxic arsenic or arsenic compounds that are health and environmental threats. Using the recovery technology, arsenic would not be released into the environment, as it was when some 1,200 tons of lewisite were reportedly poured into the ground, covered with bleach or lime, and buried close to a nearby village when the chemical weapons factories at Chapayevsk were closed down after World War II.[21] However, some critics doubt the safety of the arsenic recovery process, claiming that the process produces highly flammable and explosive compounds as byproducts.[22]

PAYING FOR RUSSIAN CHEMICAL WEAPONS DISPOSAL

The arsenic recovery program is but one attempt by Russia to recoup part of the previous investment in the huge military complex of the former Soviet Union. The United States has generally supported Russian efforts to convert traditional military facilities to commercial uses, though conflicts have arisen between the two countries when the Russian conversion programs have involved weapons of mass destruction. The United States has objected to Russian proposals to use nuclear weapons material for nuclear fuel and to convert former chemical weapons production factories into commercial chemical factories.[23] Though lewisite is considered a weapon of mass destruction, its conversion to pure arsenic should not present any security concerns for the United States—the arsenic would be no more dangerous than that already traded on the world market. However, the arsenic conversion program will not provide any significant funds for the Russian chemical weapons disposal program.

The head of the Russian Defense Ministry's Radiation, Chemical, and Biological Safety Division, General Stanislav Petrov, puts the cost of the whole disposal program at $5.36 billion, and has already publicly stated that Russia will need the five extra years allowed by the CWC to complete their chemical weapons disposal program.[24] Even with the extra five years, Russia may not be able to meet its CWC requirements. It was recently reported that Russian experts say that it will take 25 to 30 years to deal with the CW problem.[25] The chairwoman of the Duma's Ecology Committee, Tamara Zlotnikova, has stated that the ratification of the CWC was a mistake and that Russia does not have the means to destroy the weapons, adding that it would be cheaper to preserve the chemical weapon stockpile.[26] Other members of the Duma reportedly also see the ratification of the CWC as a mistake.[27]

The former chairman of the Presidential Committee for Chemical and Biological Weapons Matters, General Anatolii Kuntsevich, has claimed that to meet the requirements of the CWC, Russia will require foreign assistance of up to 80 percent of the total cost.[28] In 1998, Premier Viktor Chernomyrdin promised 500 million rubles for chemical disarmament, but by late August only 84 million rubles had been appropriated.[29] In November 1998, President Yeltsin publicly called for increased foreign aid to assist Russian meet the CWC disposal requirements.[30] The United States has become the biggest funder of the program, with $88.4 million appropriated under the CTR program for Russian chemical weapons disposal in 1999. The CTR program was never meant to pay for the Russian chemical demilitarization program, but to provide a "jump start" for the program and allow

the Russian government to use its limited resources on projects designed to improve the economy.[31] It was assumed that when the Russian economy improved, the Russian government would take over the disposal program. However, it is becoming clear that the Russian economy will not be in any shape to support the disposal program in the foreseeable future. Consequently, one option for the United States is to increase its funding of the Russian chemical weapons demilitarization program through the CTR program. Proponents of this idea usually cite the proliferation threat that Russian chemical weapons present as an argument for increased funding. Such an increase currently appears politically unlikely and, even if provided, would not guarantee that the Russian program would succeed.

Congress is well aware that chemical weapons disposal programs can be a "black hole" for money and is unlikely to be willing to increase funding for the Russian program, whose final cost and completion date remain unknown. The US stockpile disposal budget has gone from $1.7 billion to $15.7 billion since 1985 (see note 1) and, in addition, the non-stockpile disposal program is currently projected to cost $15.2 billion. Because so little material has actually been destroyed in either project, both budgets are very likely to increase.[32] The current estimates of five to eight billion dollars for disposal of the 40,000 tons of chemical agents in the Russian stockpile are significantly lower than the costs for the US stockpile disposal program. However, with no material destroyed and no disposal facilities built, this estimate may turn out to be as optimistic as the original projected cost of the United States stockpile disposal program.

WHAT ARE THE DANGERS POSED BY THE STOCKPILE?

The $88.4 million provided for Russian chemical weapons disposal in 1999 was allotted only reluctantly by the Congress. A House report stated, "Unlike strategic nuclear weapons and long-range ballistic missiles, which pose a direct threat to US security, the Russian chemical weapons stockpile poses more of a local environmental threat than it does a security threat to Americans."[33] The FY1999 Authorization Act requires that the president send written certification that the Russian government is meeting its political and financial obligations to destroy its chemical weapons. With so little money being provided by the Russian government and lingering questions about whether Russia has declared all information about its chemical weapons capabilities, especially with regard to binary weapons,[34] it is not clear that this certification will be possible. The fact that the money is largely for beginning construction of the Shuchye facility in 1999, when the facility has not even received local approval, is especially worrisome. The political climate in the United States is such that a cut in funding is more likely than an increase.

It is important to remember that even if the Russian disposal program had adequate funding, this would not guarantee the success of the program. The US stockpile disposal program has demonstrated that money alone is not enough to ensure expeditious disposal of chemical weapons. The United States program has been delayed, not because a lack of funds, but because the Army has had difficulties convincing concerned citizens and environmental groups that it can carry out the program in a safe manner. The people of Russia can see the consequences of past chemical weapons disposal and production programs in the Soviet Union, and the current Russian government is doing little to convince the people that it is any more concerned about their well-being than past governments were. Promised infrastructure improvements are not being constructed at chemical weapons storage sites. In addition, the Russian government does not acknowledge that many sites around the country are contaminated because of past chemical weapons disposal decisions. The medical concerns of ex-chemical weapons workers and of people living near contaminated former production and disposal sites are not being adequately addressed. At present, the chosen two-stage disposal technology for Russian nerve agents is being challenged. Protesting villagers near the areas where the government has decided to bury the resulting waste products from weapons disposal at Leonidovka are trying to prevent this decision from ever being implemented.[35]

Calls for increased US funding for the Russian program tend to focus on the proliferation threat that these weapons present. Similar to the "loose nukes" argument, defenders of this idea argue that terrorists or other nations might steal Russian chemical weapons or attempt to purchase the weapons from the underpaid soldiers that guard the storage sites. The security measures maintained at Russian chemical weapons sites are much more lax than those employed in the United States, so this is an issue that needs addressing.[36] One promising suggestion in this regard is the establishment by the Depart-

ment of Energy of a "lab-to-lab" exchange between security experts from the US National Laboratories and Russian chemical weapons storage sites.[37] A similar program involving nuclear security experts from both countries has been useful for Russian efforts at securing and dismantling nuclear weapons. To date, however, there are no confirmed reports of chemical weapons being diverted from Russian storage sites.

In addition, the weapons are not ready for immediate use, as has sometimes been implied.[38] The blister agents are stored in bulk and are all around 50 years old and likely quite degraded. Any theft would require siphoning of these agents out of their containers—certainly not a very inviting process—and then fabricating a means for their delivery. The nerve agents are loaded into individual munitions, so their theft is more likely. These agents also are much more deadly than the blister agents, and would be a more effective weapon. But the Russian munitions are not loaded with explosives or propellants, so anyone who acquired rounds would have to supply these (and the weapons for delivering the munitions) or, more likely, remove the nerve agent from the munitions and construct a delivery system. This could be done by a group or state with some technical expertise, but it would not be a simple task to perform. It is important to realize that fabricating an effective delivery system for a chemical weapon is often as challenging as producing the chemical agent itself.

A further reason that Russia's stockpile of nerve agents might be attractive to a terrorist group is the high purity of the agents. One reason that the Aum Shinrikyo cult's 1995 nerve agent attack in a crowded Tokyo subway, which killed 12 and injured thousands, was not even more tragic was the impurity of sarin used (as well as the primitive delivery that was utilized).[39] When originally produced, by contrast, the Russian nerve agents were undoubtedly of high purity. However, even the newest agents in the stockpile are now over ten years old, and likely have degraded somewhat. If a terrorist had to remove the agent from a munition and transfer it to a second delivery device, the highly reactive nerve agents would likely experience further degradation.

While the security threat that Russian chemical weapons present is a potential one, the weapons storage sites are already a threat to nearby communities. Even if old and degrading, chemical munitions can still be quite dangerous. Some Russian blister agents have been stored in the same containers since the 1940s, and according to Radiation, Chemical and Biological Safety Division deputy, Lieutenant General Yuri Tarasevich, "the walls of storage tanks are corroded."[40] The buildings in Shuchye where munitions containing nerve agents are stored are described as "becoming decrepit," and there are concerns that hard rains in this region could lead to a disaster, as several storage facilities have flooded in the past.[41] Many of the chemical weapons storage facilities lack a basic automatic alarm system to warn of dangerous levels of agent in the air. Hence, the greatest danger posed by Russia's CW stockpile is that people living near the storage sites will be exposed to these agents.

CONCLUSIONS

The complete destruction of Russia's chemical weapons would, of course, be in the best interest of the United States. Providing financial aid for such things as electronic monitors, better locks, and improved physical barriers, as has been suggested,[42] might offer a way to reduce any possible threat of "loose chemical weapons" at a moderate cost to the United States. However, the proliferation threat from these weapons is not great enough to justify huge funding increases for the Russian disposal program by the United States. The use of these weapons, even if stolen or bought, would not be simple, and reducing this threat by disposal could cost the United States billions of dollars. Given the limited money available for dismantling the former Soviet military complex and arsenal of weapons, these funds could be better spent on other concerns. Additionally, the Russian government's poor standing with the Russian people with regards to chemical weapons issues means that increased funding would not guarantee that the Russian program would succeed.

Russian chemical weapons, as time passes, will become even less useful as weapons, as their active agents break down, and even more threatening to the environment, as the material housing the agents deteriorates. Reducing the health and safety threats of stored Russian chemical munitions to local communities is not a goal of the Cooperative Threat Reduction program. However, the severity of the environmental threat that these storage site presents is probably a better argument for increased aid than the proliferation threat. Such increased aid is still unlikely, but the United States could provide assistance and equipment to help decrease the safety threat of these weapons without incurring the billions of dollars in costs for the entire disposal program. For ex-

ample, the United States has developed systems for detecting leaking chemical weapons and a mobile system for transporting and destroying especially dangerous weapons in a safe manner that could be supplied to the Russian government.

It is not known exactly how much the United States and the Soviet Union have paid for their decisions to maintain arsenals of chemical weapons during the Cold War, but any such accounting should include the money now needed to destroy these weapons. The United States chemical weapons disposal program began in 1986 and the Army now puts its completion date at 2007, as required by the CWC. With only about 13.5 percent of the stockpile destroyed, it is not clear that the United States will meet this requirement. The current disposal program in Russia is no further along than the United States program was in 1985, and given the lack of financial support in Russia, it is difficult to believe that program can take less time than the 20-plus years that the United States program will finally take.

With the Russian government struggling to assure that there is enough food to feed its citizens, chemical weapons disposal will likely remain a low priority. The CWC disposal deadline will undoubtedly have to be extended to deal with the situation in Russia (and perhaps in the United States). Expelling the world's largest possessor of chemical weapons from the CWC is not an attractive option, and a financial penalty levied against Russia for not being able to afford to dispose of its chemical weapons makes little sense. At least with Russia a party to the CWC, international inspectors have access to Russian storage sites. These inspections have already begun, and while they cannot guarantee that Russian weapons will not be stolen, especially in small amounts, they do provide some security against large displacements. Without an extension, Russia might withdraw from the CWC and either abandon the decision to destroy its chemical weapons or resort to such undesirable disposal options as sea dumping or open-air burning. The international community should focus on keeping Russia moving towards the goal of destroying its stocks at whatever pace it can realistically manage, while providing assistance to reduce the chances of a local environmental and health catastrophe.

[1] The US stockpile originally consisted of some 31,000 tons of unitary nerve and blister agents stored in munitions and bulk containers at eight sites in the continental United States and on Johnston Island in the Pacific Ocean. Objections from environmental and citizens' groups, who strongly objected to the Army's initial decision to build incinerators at each stockpile site to carry out the on-site destruction of chemical weapons, have caused delays in acquiring construction permits and required the Army to examine alternative disposal technologies. The cost estimate of the United States program has gone from $1.7 billion, in 1985, to $15.7 billion, and its projected completion date has been extended from 1994 to 2007. Currently, only two incinerators are operational, and only slightly more than 13.5 percent of the US stockpile had been destroyed as of March 1999. For more information about the United States stockpile see National Research Council, *Recommendations for the Disposal of Chemical Agents and Munitions* (Washington, DC: National Academy Press, 1994), pp. 34-51.

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