

## *Special Report*

---

# Strategic Offensive Arms Elimination and Weapons Protection, Control, and Accounting

---

JOHN W.R. LEPINGWELL & NIKOLAI SOKOV

*Dr. John W.R. Lepingwell is Senior Scholar-in-Residence and Manager of the Newly Independent States (NIS) Nonproliferation Databases in the NIS Nonproliferation Project at the Center for Nonproliferation Studies (CNS). Prior to joining CNS in 1996, he was Assistant Professor at the University of Illinois at Urbana-Champaign. Dr. Nikolai Sokov is a Senior Research Associate at CNS. From 1987-92, he worked at the Ministry of Foreign Affairs of the Soviet Union and Russia, during which time he participated in the START I and START II negotiations.*

**T**he destruction of strategic nuclear weapons and the protection of nuclear warheads are core tasks for the Cooperative Threat Reduction (CTR) program. It is in these areas that the CTR program has scored its greatest successes, including the removal of nuclear weapons from Belarus, Kazakhstan, and Ukraine. While now taken for granted, the successful denuclearization of these countries required skillful diplomacy and appropriate inducements for these countries to join the nuclear nonproliferation regime. The CTR program provided the infrastructure and support that made these breakthroughs possible.

This report looks at the status of current programs for strategic offensive arms elimination and nuclear weapons protection, control, and accounting. It examines whether these programs address current threats and issues, both in nonproliferation and arms control, whether they are progressing satisfactorily, and what might be done to make the programs more effective.

### **CTR PROGRAM ORIGIN AND PURPOSE**

The CTR program, otherwise known as “Nunn-Lugar” (after sponsoring Senators Sam Nunn [D-GA] and Richard Lugar [R-IN]), was established by the Soviet Nuclear Threat Reduction Act of 1991. It set forth the following objectives:

- A) to facilitate on a priority basis the transportation, storage, safeguarding, and destruction of nuclear and other weapons in the Soviet Union, its republics, and any successor states; and
- B) to assist in the prevention of weapons proliferation.

The first allocation, for fiscal year (FY) 1992, comprised \$400 million.<sup>1</sup>

On October 11, 1993, the Soviet Nuclear Threat Reduction Act evolved into the Cooperative Threat Reduction Act of 1993 as part of the FY94 National Defense Authorization Act, meaning the Department of Defense

(DOD) would have primary responsibility for the program. The CTR program's main objectives were expanded so that they now included the following areas: (1) warhead removal from the Soviet successor states to Russia; (2) destruction and dismantlement of weapons systems; (3) chain of custody projects; (4) chemical weapons destruction assistance; and (5) demilitarization support.<sup>2</sup>

The program had a slow start. The US initiative in 1991 took the Soviets by surprise. Subsequent US-Soviet consultations demonstrated that, to begin with, the Soviet and after them the NIS militaries had only a general idea about what they actually needed. For example, transportation of nuclear weapons required containers, railcars, armored blankets, and some other items. But there were no specific figures for how many of these items were actually needed. Second, NIS defense officials had lingering concerns about granting access to top-secret facilities and information to Americans. The breakup of the Soviet Union soon after the money was appropriated, and the associated problems of control over nuclear weapons, slowed down the implementation of the program even further. For all these reasons, the framework agreement between the United States and Russia was not signed until June 17, 1992 (it was extended on June 15, 1999, for a period of seven years). Similar agreements were signed with Belarus on October 22, 1992, Ukraine on October 25, 1993, and Kazakhstan on December 12, 1993. Some assistance, however, was sent even before formal agreements were signed.<sup>3</sup>

Thus, the period of 1992 to 1993 was primarily devoted to establishing the outlines of the program and its legal foundations, both through intergovernmental agreements and relevant domestic legislation. The years of 1994 to 1995 were primarily devoted to putting in place a management structure and developing acquisitions strategies. Assistance was given throughout both these stages, but it was primarily concentrated on the original goals of the program, i.e., safe transportation of nuclear weapons. During the period of 1992 to 1996, nuclear warheads were transported to Russia from other NIS states and efforts to concentrate the warheads inside Russia itself were initiated.

The CTR program reached the stage of maturity only in 1996. Most of the achievements of the program belong to the period between 1996 and the present; this is also the time when the organizational and contractual

arrangements were put in effect and when implementation of the program has been the smoothest.

## PROGRAMS, PROGRESS, AND PROBLEMS

The strategic offensive arms elimination (SOAE) and nuclear weapons protection, control, and accounting (WPC&A) projects concentrate on two closely related problems: destroying launchers and ensuring the safe transport and storage of nuclear warheads. The SOAE project assists in elimination of launchers and delivery vehicles in accordance with START I, while the WPC&A project provides for the safe and secure transport and storage of the nuclear warheads removed from the delivery vehicles. Taken together these two projects account for almost three-quarters of all CTR funding, and form the core of the CTR program.<sup>4</sup>

### Launcher Elimination (SOAE) Project Progress

The SOAE program has assisted Belarus, Kazakhstan, and Ukraine in eliminating their Soviet nuclear legacy, and is assisting Russia in meeting its START I dismantlement obligations. After a brief summary of the progress to date on a country-by-country basis, this section will detail the problems that remain to be addressed.

**Kazakhstan:** The SOAE project has been most successful in Kazakhstan, where the Soviet nuclear weapons infrastructure has been completely eliminated (see Figure 1). As a result, Kazakhstan is in compliance with its START I, Lisbon Protocol, and nuclear Non-Proliferation Treaty (NPT) obligations. With all silos eliminated and all tunnels sealed there is no further SOAE activity in Kazakhstan.

**Belarus:** The situation in Belarus is quite different from that in Kazakhstan. A CTR umbrella agreement was signed with Belarus in October 1992, and programs began to be implemented in several areas.<sup>5</sup> However, after the election of President Aleksandr Lukashenka in summer 1994, relations between Belarus and the United States deteriorated, especially when Belarusian officials began to hint that Belarus might retain some ICBMs on its territory. After several delays, and due to pressure from the United States and Russia, the remaining SS-25 ICBMs were transferred from Belarus to Russia in November 1996. However, the worsening climate in US-Belarusian relations and increased human rights violations in Belarus resulted in the suspension of CTR assistance to Belarus in March 1997. Equipment pro-

vided by the United States for the destruction of SS-25 launch positions was withdrawn, and dismantlement work stopped. Belarus also had over 1,000 metric tons (MT) of liquid rocket fuel, and 9,000 MT of oxidizer, which were to be eliminated with CTR funding. The current status of this material is uncertain.<sup>6</sup> The 1992 CTR umbrella agreement expired in 1997, and any resumption of CTR funding would require not only a new agreement but also a major change in US-Belarusian relations. Such a change seems highly unlikely as long as President Lukashenka remains in power and controversy over human rights in Belarus continues.

**Ukraine:** The SOAE project played an important role in convincing Ukraine to return its nuclear missiles and warheads to Russia. Elimination of 130 SS-19 silos was completed in December 1998, and the SS-19 missiles were dismantled by February 1999.<sup>7</sup> All SS-24 ICBMs have been removed from their silos, with all silos scheduled for destruction by the end of 2001. After lengthy negotiations, Ukraine and Russia reached an agreement in summer 1999 on the transfer to Russia of 11 out of the 44 heavy bombers left in Ukraine, as well as approximately cruise missiles.<sup>8</sup> Ten bombers were to have

been destroyed by January 2000, leaving 21 to be destroyed before the end of the project in early 2001.<sup>9</sup>

**Russia:** The size of the Russian nuclear weapons infrastructure dwarfs that of the other former Soviet republics and poses a correspondingly greater challenge. If START II is ratified, Russia must eliminate approximately 200 silos, 1,400 missiles, and 50 bombers by 2007.<sup>10</sup> The SOAE project's progress in Russia has been substantial, with over 40 heavy bombers destroyed and hundreds of silos and missiles dismantled (see Figure 1).

**Work in Progress and Remaining Problems:** While the SOAE projects are making good progress in meeting their goals, there are some areas where the projects in both Russia and Ukraine are meeting delays and difficulties. In the case of Russia, in particular, these delays raise some doubts as to the effectiveness of parts of the CTR program.

The basic agreement for SOAE projects in Russia was signed in 1992, with a further agreement broadening and increasing US support (especially for fuel elimination programs) following in 1995.<sup>11</sup> A new umbrella agree-

*Figure 1: CTR Strategic Offensive Arms Elimination Project Accomplishments and Issues*

<p><b>Belarus:</b></p> <ul style="list-style-type: none"> <li>• All ICBMs and warheads removed by November 1996</li> <li>• CTR assistance suspended in March 1997, equipment removed</li> <li>• 1,000 MT of liquid rocket fuel, and 9,000 MT of oxidizer remain</li> <li>• Destruction of garages (launch positions) for SS-25s apparently ceased</li> </ul> <p><b>Kazakhstan:</b></p> <ul style="list-style-type: none"> <li>• 104 ICBMs, 40 bombers, estimated 1,400 warheads returned to Russia</li> <li>• 148 ICBM launchers eliminated</li> <li>• 178 nuclear test tunnels sealed</li> </ul> <p><b>Ukraine:</b></p> <ul style="list-style-type: none"> <li>• 130 SS-19 silos destroyed by December 1998, all SS-19s dismantled by February 1999</li> <li>• All 46 SS-24s off alert, several removed from silos</li> <li>• 10 heavy bombers to be eliminated by early 2000, 11 to be transferred to Russia</li> <li>• Silo dismantlement and bomber elimination to be completed in 2001</li> <li>• Liquid- and solid-fuel elimination facilities to be built</li> </ul> <p><b>Russia:</b></p> <ul style="list-style-type: none"> <li>• 200 silos, 1,400 missiles, and 50 bombers to be eliminated by 2007, if START II ratified</li> <li>• Approximately 120 silos destroyed, 247 ICBMs eliminated, 42 bombers destroyed</li> <li>• 916 solid-fuel motors to eliminate, 153,000 tons of liquid rocket fuel to eliminate</li> <li>• Oxidizer conversion plants now in operation</li> </ul>
---

ment, extending the CTR program for another seven years, was signed in June 1999.<sup>12</sup> For FY 2000 over \$182 million is budgeted for SOAE projects in Russia, compared to \$35 million for Ukraine.<sup>13</sup>

One reason that SOAE projects have run relatively smoothly in Ukraine and Kazakhstan is that these states are no longer nuclear powers, and do not have to guard operational secrets. In Russia, the higher level of secrecy has complicated several SOAE projects. Thus, while ICBM silo elimination in Ukraine and Kazakhstan was conducted by US contractors working with local personnel and companies, in Russia a different approach is required. Instead of contracting for the destruction of silos, in Russia the United States provides equipment to be used by Russian personnel to destroy silos. It is therefore difficult to provide an accurate count of the number of Russian silos destroyed with CTR-provided equipment, but it appears that some 120 silos in Russia have been dismantled with US aid.<sup>14</sup> The destruction of Russian heavy bombers is an easier task. The procedure is technologically simpler, does not involve secrets, and has been proceeding at a rapid pace with 42 bombers destroyed by late 1999.<sup>15</sup>

Even more challenging than destroying silos is the creation of a nuclear weapons elimination infrastructure for Russia that will ensure the environmentally safe destruction of missiles and their fuel. While the Soviet Union created a massive infrastructure to create nuclear weapons, little thought was given to the future problem of destroying obsolete or unnecessary systems. As a result, the CTR program is assisting Russia and Ukraine to create facilities for the destruction of liquid-fuel and solid-fuel missiles. These projects go beyond the narrow requirements of launcher elimination called for under START, but are consistent with the original intent of the CTR program. However, they are proving difficult and controversial.

Liquid-fuel disposition is complicated by the highly toxic nature of the fuel and the corresponding need for specialized handling and processing facilities. Most Russian liquid-fuel missiles, both ICBMs and sea-launched ballistic missiles (SLBMs), use highly toxic heptyl (UDMH) as the fuel, and a nitrogen-based oxidizer, both of which can be converted to civilian-use chemicals.<sup>16</sup> According to Russian estimates, some 100,000 MT of liquid fuel were in storage in 1997, with an estimated 20,000 MT to be removed from missiles by 2005.<sup>17</sup> The CTR program estimates the total amount

at 30,000 MT of heptyl and 123,000 MT of oxidizer.<sup>18</sup> Originally, heptyl was to be converted at three facilities: Sergiyev Posad, Krasnoyarsk, and Nizhnaya Salda. Opposition to the construction of the facility in Sergiyev Posad led to the decision to build two conversion plants at Krasnoyarsk, resulting in a delay of at least several months.<sup>19</sup> Oxidizer is to be converted to other nitrate-based compounds for civilian use, with one of the plants to be sited at Sergiyev Posad.<sup>20</sup> The de-fueled missiles are dismantled at Surovatikha and Pibanshur; apparently the Ministry of Defense is selling the resulting metal components to raise funds.<sup>21</sup> Over 247 liquid-fuel ICBMs had been eliminated by December 1998.<sup>22</sup>

Some reports suggest that the liquid-fuel storage problem has reached critical levels, with storage facilities for propellant almost literally overflowing. As long ago as February 1997, one of the Russian generals responsible for liquid-fuel disposition warned that storage capacity "is totally inadequate and there aren't enough rail tank cars for transportation."<sup>23</sup> While the US delivery of railcars may have alleviated the transport problem, getting the conversion plants operational should be a high priority. At least one report, however, suggests that the plant components were delivered to Krasnoyarsk and stood in containers for over six months while the Russian side insisted that it could not fund the electrical infrastructure improvements needed to power them. The United States reportedly funded the infrastructure development and the facilities were reported to be operational as of late 1999.<sup>24</sup>

Similar problems have delayed the construction of a plant to eliminate at least 916 motors from solid-fuel ICBMs and SLBMs.<sup>25</sup> The contract to build the elimination facility was awarded to Lockheed-Martin in mid-1997, and Perm was chosen as the site due to the existence of a similar Soviet-era facility.<sup>26</sup> The new facility was to dispose of the solid-fuel motors by burning them in a closed chamber, with all exhaust gasses collected in order to protect the environment. While two missile test stands had been used during the Soviet period without any filtering of the missile exhaust, the proposal to conduct large-scale missile dismantling produced strong opposition from the local populace and government.<sup>27</sup> A facility with a capability to collect exhaust gasses was undergoing tests in the early 1990s, but never reached industrial scale due to lack of funding. There is some evidence that the local government used opposition

to the facility to enhance its own popularity, rather than trying to “sell” the project to the population.<sup>28</sup>

This opposition forced the Russian government to propose building the facility in Votkinsk, the same city where solid-fuel ICBMs are produced. In Votkinsk, local opposition again arose, culminating in a local referendum in which 94.6 percent voted against construction of the facility.<sup>29</sup> While the referendum was not binding, construction was delayed throughout 1999. After the election of a new municipal government, and a concerted effort to “sell” the project, opposition appears to be waning and construction may begin in spring 2000.<sup>30</sup>

The result has been at least a two-year delay in construction, and a corresponding delay in the solid-motor elimination process. Furthermore, compared to Perm, the site in Votkinsk is unprepared and the facility will have to be built from scratch, resulting in higher costs and longer construction time. There are also some growing concerns that the facility in Votkinsk, once built, may not be sufficient to handle all the motors. General Lieutenant (retired) Vasilii Lata, former first deputy chief of the Strategic Rocket Forces (SRF) Main Staff, has argued that two elimination facilities are required for START II implementation, and that the Perm facility should also be built.<sup>31</sup>

As a result of these problems with liquid- and solid-fuel disposition, the creation of the “elimination infrastructure” has been delayed by at least two years. In spite of this delay, destruction of silos and elimination of liquid-fuel missiles continues. However, the risk of an accident may be increasing over time, as more liquid fuel stays in storage and as solid-fuel rocket motors deteriorate. Delays may also drive up costs, as repeated studies have to be made, plans adjusted, and projects re-engineered.

Similar problems with solid- and liquid-fuel disposition are being encountered in Ukraine, albeit on a smaller scale. Ukraine must dispose of liquid fuel from 111 SS-19 ICBMs and solid rocket motors from 54 SS-24 ICBMs.<sup>32</sup> For solid fuel, Ukraine, in contrast to Russia, has chosen a “wash-out” technology in which the solid rocket propellant is washed out of the rocket casing with high-pressure water, resulting in a slurry that can be processed for use in civilian explosives. This technology, developed by Thiokol, has strong high-level support in Ukraine, because it provides a civilian product and because motor burn-out is considered environmentally

unsound and potentially unsafe. While the technology has been chosen, a contract has not yet been signed. Also, construction of the facility has not begun, although it is expected to be located at the Pavlograd Chemical Plant where the SS-24s were assembled. Some local residents, as well as the head of the regional Ecological Safety Department, have expressed concern over the storage of a large number of solid-rocket motors near a populated area, but opposition does not appear to be widespread.<sup>33</sup>

Liquid fuel is to be converted at the Pavlograd Chemical Plant. All of the SS-19s have been defueled and dismantled, and the fuel (heptyl) and oxidizer are in storage. As in Russia, scrap metal from the destroyed missiles is being sold by the Ministry of Defense to recoup destruction costs and provide funding for conversion and housing programs.<sup>34</sup> However, as of mid-1999, a technology for heptyl processing had not been chosen, and it remains uncertain when construction on a facility will begin.<sup>35</sup>

The fact that Ukraine and Russia must eliminate some of the same missiles leads to a serious duplication of effort. Both countries are planning to build solid-fuel elimination facilities, as well as liquid-fuel conversion plants. Given that building a solid-fuel motor elimination facility costs approximately \$50 million, while the Russian mobile oxidizer processing systems (MOPs) project will cost over \$8 million, this duplication must be questioned.<sup>36</sup>

At first glance, given the smaller volume of solid-rocket missile elimination to be carried out in Ukraine, it might be preferable to consolidate all solid-fuel elimination in Russia. While there may be a political reason for duplicating facilities in both countries, there does not appear to be a clear technical justification for doing so. It is striking, but perhaps not surprising, that the two countries have chosen completely different elimination techniques for the same motors. We recommend that the CTR program commission a detailed technical review in order to ascertain whether one technology is superior, and whether both liquid- and solid-fuel disposition facilities could be consolidated.<sup>37</sup> The savings from such a consolidation could then be directed to other parts of the CTR program.

There are some additional questions that arise concerning the dismantlement of missiles in both Russia and Ukraine. In one well-documented case, gyroscopes from SS-N-18 SLBMs were discovered in Iraq, having

been shipped there after being removed from dismantled missiles.<sup>38</sup> While these SLBMs probably were not dismantled with CTR assistance, the possibility of leakage of sensitive components deserves serious attention due to the advantage it would give a proliferant state were it to obtain guidance system components.

For missiles being dismantled in CTR-funded facilities in Russia and Ukraine some monitoring procedures are in place, and in Russia, special procedures provide for the destruction of at least some sensitive components in the presence of US representatives.<sup>39</sup> In Ukraine, however, missile guidance components have reportedly been warehoused, pending a decision on their final disposition.<sup>40</sup> We recommend that the CTR program consider a plan to purchase these components at a fair price, and subsequently destroy them.

Overall, the launcher elimination projects appear to have been relatively successful. The goal of the projects is clear, and at least the initial steps have been relatively straightforward. As the process of destruction becomes more complicated, however, political and environmental concerns must be taken into account earlier in the projects in order to avoid extensive delays.

### WPC&A Project Progress

The breakup of the Soviet Union, and the subsequent political and economic instability in Russia brought to the forefront the issue of nuclear weapons protection, control, and accounting.

The problem that first received attention was transportation of nuclear weapons. As the Soviet Union was breaking apart and ethnic and political conflicts multiplied, the Soviet military embarked on consolidation of nuclear weapons. In the fall of 1991, after unilateral parallel statements by George Bush and Mikhail Gorbachev, thousands of tactical nuclear weapons had to be shipped to central storage facilities and/or elimination facilities. Beginning in 1992, nuclear weapons had to be withdrawn from Belarus, Kazakhstan, and Ukraine to Russia. This created an unprecedented volume of "nuclear traffic" with which the Soviet, and then Russian, military had a hard time coping, especially given the sharply increased danger of accidents and risk of hijacking attempts by various political and paramilitary groups.

Consequently, it was appropriate that the initial emphasis was on protection of warheads during transit, as well as support for emergency services in case of an ac-

cident. The CTR program's provision of supercontainers, kevlar blankets, and special railcars played an important role in assuring all parties of the safe transfer of warheads from the former Soviet republics to storage sites in Russia.<sup>41</sup> The initial deliveries for this project are now complete.<sup>42</sup> Of the equipment, 100 railcars were produced in Russia with the United States providing money and some materials to build them; the rest of the equipment was produced in the United States and delivered to Russia. The program is continuing, however: on November 1, 1999, the Department of Defense and the Defense Ministry signed a new memorandum on \$41.7 million of additional assistance for the purchase of security systems for railcars.<sup>43</sup> Apparently, the new assistance is aimed at replacement of railcars that are wearing out.

While the transfer of warheads went smoothly, there was increasing concern in the mid-1990s that the Soviet system of security was no longer adequate under the new conditions in Russia. Because of the strict secrecy imposed on issues pertaining to Russian nuclear weapons storage, it is difficult to assess the level of threat posed. Nevertheless, there is sufficient public data to suggest that Russian nuclear weapons protection, control, and accounting needs to be reinforced to face a variety of challenges.

The threat to Russian nuclear weapons may come from "insiders" such as poorly paid and demoralized officers in isolated garrisons, "outsider" threats by armed terrorist groups, or a mix of the two. The worst case, the successful theft and transport outside of Russia of a nuclear weapon appears very improbable, but there are other scenarios, such as an attack on the weapons themselves, that are more credible. There have been numerous incidents of Russian servicemen in the conventional forces attacking their comrades, leading to hostage-takings, shootings, and related violence. Given military-wide morale problems, similar incidents at nuclear bases or facilities could occur.

The 12<sup>th</sup> Main Directorate of the Russian Ministry of Defense is responsible for the maintenance, transport, safety, and support of nuclear warheads. Until mid-1998, storage responsibilities at operational bases were borne by the 6<sup>th</sup> Main Directorate of the service operating the base.<sup>44</sup> Open-source estimates suggest that there may be 65 to 75 nuclear weapons storage sites in Russia operated by the 12<sup>th</sup> Main Directorate.<sup>45</sup> After the absorption of the 6<sup>th</sup> Main Directorates from each of the services,

the number of personnel in the 12<sup>th</sup> Main Directorate rose to 30,000, of which 45 percent are officers.<sup>46</sup>

The incorporation of service-level facilities may have resulted both in improved standards at the sites and increased problems for the 12<sup>th</sup> Main Directorate. Only a few months after the 12<sup>th</sup> Main Directorate took over responsibility for the nuclear testing site at Novaya Zemlya Island, an incident took place in which a group of five servicemen of Dagestani nationality took over 50 hostages. While this incident ended without any serious injuries, and no nuclear weapons were located at the facility, it focused the 12<sup>th</sup> Main Directorate's attention on facilities transferred from the services, at which personnel screening may have been lax. In October 1998, in response to this and other incidents at nuclear sites, the Ministry of Defense issued a new directive that tightened the selection of troops for the 12<sup>th</sup> Main Directorate. While details are not available, this measure appears to provide for stricter background checks and requires that conscripts have clean records.<sup>47</sup>

There are also broader trends in the Russian military that cause concern. Russian media reported recently that drug-related crimes in the SRF increased 2.4 times from 1995 to 1998.<sup>48</sup> Similarly, there are reports of organized-crime rings operating in the Northern Fleet, with thefts of everything from torpedo parts to wire from reactor control systems.<sup>49</sup> There are even allegations of corruption at the highest levels of the SRF (such as exchanging cable for bricks to build dachas) and the 12<sup>th</sup> Main Directorate.<sup>50</sup> These may be cases of "routine corruption" in which otherwise honest officers and servicemen resort to "moonlighting" and black-marketeering in order to make ends meet. Yet, the trends indicate that this criminality may be increasing in intent and seriousness, and affects even the units responsible for the safety of nuclear weapons.<sup>51</sup>

These problems underline the urgency of ensuring robust physical protection and the highest levels of personnel reliability at Russian nuclear weapons sites. The initial stages of the WPC&A program, in which supercontainers, railcars, and other equipment were delivered, paved the way for its extension into more sensitive areas, such as the upgrading of nuclear weapons storage sites. In 1995, agreements on WPC&A were signed that extended the initial CTR program in this area, and since then \$133.2 million has been appropriated for this project.<sup>52</sup> However, given Russian

concerns over secrecy, progress has not been rapid, and many difficulties remain.

The first step in providing physical protection upgrades was the delivery of "quick fix" packages of fencing and related physical protection equipment for 50 Russian nuclear weapons storage sites. These packages consist of Russian products, paid for by the CTR program, with the Russian company Tenzor as the lead contractor. By the end of 1997, 50 kilometers (km) of fences and equipment had been delivered, and an additional 100 km of fencing were supplied in 1998.<sup>53</sup>

The second step in enhancing weapons protection was the creation of the Security Assessment and Training Center (SATC) in Sergiyev Posad, which was commissioned in November 1999. This facility features a full-scale external testbed for joint US-Russian testing and evaluation of physical protection systems, as well as a mock-up of the interior of a weapons storage bunker. The site will be used to evaluate equipment and requirements for the next stage in WPC&A assistance, which is to extend upgrades to 123 sites in Russia. Training of 12<sup>th</sup> Main Directorate troops on the new systems will also be carried out at Sergiyev Posad. As of late 1999, the facility was still undergoing final testing.<sup>54</sup>

US assistance for Russian personnel reliability programs is also being consolidated at the SATC. Polygraphs (lie detectors), drug and alcohol test kits, and an analysis and testing laboratory were delivered in 1997-98 as part of this program.<sup>55</sup> According to one report, some five percent of those taking the test have failed and been reassigned from nuclear weapons protection work.<sup>56</sup>

The United States is also providing a computerized system for warhead accounting, which will include computers and network servers for tracking warheads in transit and storage. The system will replace a more traditional, outdated accounting system that is based on a "paper trail." A prototype system was delivered in October 1996, with an additional 50 computers shipped in May 1998, and the system is expected to be operational in early 2001.<sup>57</sup>

These projects cover the most urgent problems in the WPC&A area; however, judging their effectiveness is more difficult than for SOAE projects. It is easy to count destroyed silos or chopped-up bombers, but such criteria are not applicable in this case. While increased security can be measured using assessment programs, the

question of “how much is enough” depends on subjective risk assessments. The appropriate question, then, is whether potential WPC&A vulnerabilities are being assessed in an effective and timely manner.

Using these criteria, several concerns emerge. First, the deterioration of nuclear weapons storage conditions presumably started when the defense budget plunged after the dissolution of the Soviet Union. Problems have therefore been accumulating for several years, and may take even longer to fix. To a large extent the delay in providing assistance was due to Russian reticence to request assistance in this sensitive area. Now that upgrades to physical protection are starting, however, they will have to proceed rapidly in order to compensate for the weaknesses developed over the years. While “quick fix” packages may patch some security problems, a more thorough upgrading of facilities is an urgent task.

The second, and more serious, cause for concern in the WPC&A area is the problem of secrecy, which has greatly complicated transparency and accounting measures. CTR projects are held to strict accounting standards that inevitably collide with Russia’s strict secrecy standards. Russia has a legitimate interest in maintaining secrecy concerning nuclear storage sites, particularly given possible terrorist threats. However, this interest may conflict with programs intended to minimize such threats.

While there have been reciprocal visits by high-ranking officers to Russian and US nuclear weapons storage sites, such visits are rare. A single visit is far from adequate to determine either the overall level of protection at Russian sites, or to determine if equipment is being properly used.<sup>58</sup> Transparency measures such as providing pictures and videos of installations have been proposed, but the US side contends that these materials do not conclusively prove that the work has been done at the specified site.

One option is to designate a “trusted agent,” a person who has clearance for access to a particular site and enjoys the trust of the US side. For example, the CTR program is now paying for the railroad shipment of warheads to dismantlement facilities. Since the shipment and routing of warheads are closely held secrets, direct access to transportation logs is not allowed, and a “trusted agent” is used to verify that claimed shipments are being carried out.<sup>59</sup> These measures may go some way towards providing the level of accountability required by the

United States, but might not be sufficient to fully resolve the differences. By its very nature, this problem may require management rather than a solution; compromises will have to be made on both sides. The issues of access and transparency will have to be resolved, however, if an expansion of physical protection assistance to additional sites is to take place.

Third, Russian secrecy may keep the United States from determining whether assistance is going to the most high-priority cases. While 50 quick-fix sets have been delivered, this falls far short of the best open-source estimate of 80 storage sites, and even further short of the 123 sites to be upgraded under the next phase of the program. This suggests that the quick-fix upgrades are primarily oriented towards the storage facilities of the 12<sup>th</sup> Main Directorate, and that the additional sites are former service-level facilities that were under the 6<sup>th</sup> Main Directorates.<sup>60</sup> However, it is the latter set of sites that may be in most dire need of upgrading, particularly those storing an estimated 4,000 tactical nuclear weapons. Reports suggest that these sites are overcrowded and poorly protected.<sup>61</sup> Since tactical nuclear weapons may have less reliable permissive action links (PALs) to prevent unauthorized use, their deployment at these potentially more vulnerable locations is cause for concern. Indeed, both internal and external threats may be greatest at smaller sites in more remote locations, where reaction forces may be smaller, living conditions worse, checks on internal threats fewer, and central oversight weaker. Whether these sites have been included in the quick-fix physical protection upgrades and whether a “quick fix” would even be sufficient to resolve their problems remain important, but apparently unanswered, questions.

One solution is to make upgrading smaller nuclear storage sites the highest priority. Without adequate transparency, however, any program to prioritize implementation by site entails some agreement on priorities, information on how many sites fall under different priorities, and some kind of assurance that this process is being implemented at the sites specified. Given the urgency of the situation, however, agreement upon the prioritization may have to be sufficient, with requirements for proof of installation at specific facilities relaxed.

Fourth, none of these projects directly address the impoverished living conditions that could lead to personnel reliability problems and internal threats. Russian

requests for assistance for both 12<sup>th</sup> Main Directorate and SRF personnel have been frequent, citing figures such as 2,000 12<sup>th</sup> Main Directorate and 11,000 SRF officers without homes.<sup>62</sup> Nevertheless, while houses were built in Ukraine, and assistance to convert a factory to housing was provided to Russia, the US Congress has expressly forbidden any further defense-conversion-related activities.<sup>63</sup> While the CTR program may not pay for living condition improvements directly, it may already be doing so indirectly. US funding for WPC&A projects is reportedly double the 12<sup>th</sup> Main Directorate's annual budget,<sup>64</sup> suggesting that some of the Russian budget funds freed by US assistance might be directed towards better housing and on-time salary payments.

Fifth, there is some question whether even the highest echelons within the Russian military have a clear understanding of the strengths and weaknesses of their WPC&A program. The Soviet military was not known for encouraging candor or whistle-blowing on the part of its officers, and there is good reason to believe that suppression of bad news and "cooking" of performance ratings continues in the Russian military. Yet, there is virtually no civilian oversight, or even objective military oversight, that might counter misinformation. While select members of the Russian Duma visited a nuclear weapons site in 1999, there is no level of oversight comparable to that exercised by the US Senate. This is, of course, a matter of civil-military relations and falls beyond the purview of the CTR program.

Yet the CTR program could fund innovative approaches to testing weapons security that go beyond the SATC. Several observers, including the commander of the US Strategic Forces, General Habiger, have noted that Russian nuclear weapons access procedures and regulations are very tight, and in some cases are stricter than US regulations. Yet, strict procedures are only effective if they are followed. To determine whether procedures are followed, a special inspection group of "trusted invaders" should be formed. This inspection group, preferably outside the direct command chain of the 12<sup>th</sup> Main Directorate, would be tasked with the "legal infiltration" of nuclear weapons sites. A small unit of extremely trustworthy and knowledgeable inspectors from outside a site could determine whether procedures are being followed by "gaming" the system and attempting to acquire unauthorized access. Such inspections are performed in the US and can result in reports of serious

breaches of procedures and security.<sup>65</sup> As far as we can determine, no such inspections are conducted by the Russian military.<sup>66</sup>

Given the importance of nuclear weapons protection it should receive the highest priority within the CTR program. But because of the secrecy surrounding this component of the program, it is difficult to determine whether expanded funding is necessary. If agreement on access and transparency is reached, however, programs to deliver additional physical protection upgrades could be accelerated, while additional testing kits and devices for personnel reliability programs could be procured and distributed to units. These steps, taken together with longer-term initiatives to improve internal accountability through inspections, and increased Russian funding for WPC&A, could help solve the current problems within several years.

## CRITIQUES OF THE CTR PROGRAM

Past assessments of Nunn-Lugar assistance, and the CTR program in particular, have identified a number of problem areas on the US side including:

- slow pace of implementation;
- lack of flexibility in accounting and contracting procedures;
- high level of bureaucracy;
- use of US contractors instead of local firms;
- lack of information on current funding; and
- too much "nuclear tourism."<sup>67</sup>

In the past few years, many of these issues have been at least partially resolved. Our assessment has found that:

- the pace of implementation has improved, although some problems remain;
- some flexibility in accounting and contracting procedures exists;
- the US CTR bureaucracy is reasonably well organized;
- local contractors and firms are increasingly being used;
- lack of information, and fluctuating funding remain a problem; and
- "nuclear tourism" seems to have declined, at least in the DOD CTR program.

One of the primary changes in the CTR program since 1995 is the transfer of funding and responsibility for fissile material control (MPC&A), the International Science and Technology Center (ISTC), and other non-mili-

tary aspects of Nunn-Lugar assistance from DOD to other US government agencies. This has allowed a tighter focus on core responsibilities for the CTR program.<sup>68</sup>

At the same time, some variants of past problems remain, and some new issues have arisen that require closer attention.

### **Organizational and Bureaucratic Issues**

The current administrative and bureaucratic arrangements on the US side appear adequate, although it took several years to find the right distribution of responsibilities among various agencies. Similarly, in Ukraine a relatively effective administrative system was set up to handle CTR projects.<sup>69</sup> On the Russian side, however, effective administration is greatly complicated by the ongoing reform of the government, whereby some agencies are eliminated, others are created, and responsibilities are constantly redistributed.

At the inception of the CTR program, primary responsibility for the SOAE project was given to the State Committee for Defense Industries (established 1992), which became the Ministry of Defense Industry in 1996. The latter was disbanded in March 1997, with responsibility for the SOAE project transferred to the Ministry of the Economy. At the same time, implementation of the project was transferred to the Russian Space Agency (RSA, now renamed Russian Aviation and Space Agency, RASA). The result is a more complicated implementation system with responsibility divided between two government departments, neither of which has arms elimination as its primary responsibility. While experienced personnel, especially in RASA, have remained in charge of much of the work, this arrangement is less efficient than the earlier organization.<sup>70</sup>

A side effect of the existing administrative arrangements in Moscow is the stronger influence of interest groups upon CTR-related decisionmaking. Thus, the Moscow Institute of Thermal Technology, which is responsible for solid-rocket design and production at Votkinsk, reportedly lobbied hard for the transfer of the solid-rocket elimination facility to Votkinsk.<sup>71</sup> This problem is appreciated by Russian experts who work on CTR-related issues, and there are proposals to create a single agency with authority over arms control implementation and CTR projects.<sup>72</sup> Turf wars have so far prevented any improvement in this area.

Privately, US agencies and contractors express a desire to streamline the bureaucracy on the Russian side and enhance contacts with those responsible for implementation. Interviews Russian personnel also demonstrated a strong desire on the part of the implementation groups, such as RASA, for more direct contacts with their American counterparts.<sup>73</sup> Although the US government correctly avoids interference in Russian internal administrative affairs, it seems that there is a consensus on both sides with respect to the decisionmaking system on the Russian side. These issues need to be discussed.

### **Financing and Contracting Issues**

One of the strongest criticisms leveled against the CTR program in its early years was that most of the money was being spent in the United States, rather than in Russia.<sup>74</sup> While for some projects (e.g. provision of kevlar blankets), purchase of US goods was appropriate because of their superior quality or availability, this was not always the case. Over time, however, the amount of work carried out in Russia (and other countries receiving CTR funding) has increased. According to Russian and Ukrainian unofficial estimates, the mix between locally produced and imported equipment is now about optimal.<sup>75</sup> The only remaining problem is that no indigenous companies are chosen as general contractors. Russian representatives cited as a positive fact that all bids include the use of Russian technologies and Russian producers for some equipment.<sup>76</sup>

Another positive development in contracting procedures is the effort by the United States to identify Russian or other indigenous contractors who can bid on projects on a firm fixed-price basis. A firm fixed-price contract for CTR work in country (in this case for a US contractor) was first used for silo destruction in Kazakhstan, where the project was completed several months earlier than scheduled. The same option was subsequently chosen for elimination of submarines in Russia.<sup>77</sup> This method saves about 40 to 60 percent of the contract total by eliminating the overhead of the general contractor, leaving more money for the actual work. An unexpected benefit yielded from the contract with Russian shipyards for submarine elimination was that the shipyards made a fast transition to Western-style accounting practices and greatly reduced their overhead costs. In this way,

internationally accepted market practices are penetrating the Russian defense industry at an unprecedented pace.<sup>78</sup>

### **Taxation and Immunity Issues**

One issue that has not yet been satisfactorily resolved is taxation of CTR assistance. The heart of the tax problem is the desire by the relevant Russian authorities, whose main responsibility is finding sources of revenue, to tax CTR-related assistance. While CTR assistance was supposed to be exempt from Russian taxes, the legal status of this agreement was uncertain, and bureaucratic implementation of its provisions was complex and contentious, resulting in a number of “gray areas.”<sup>79</sup> Although direct US assistance as a rule was not subject to taxes, subcontractors (i.e., US and foreign companies) often were taxed, especially since many forms of contracts could be construed as services rather than participation in an assistance program. Taxes levied on subcontractors automatically increased the cost of contracts and required additional spending. Similar problems existed in Ukraine and Kazakhstan, but were resolved (except for some recent attempts by local authorities in Ukraine to tax CTR money).<sup>80</sup> A bill to formalize the tax-exempt status of foreign assistance was submitted, apparently with government backing, to the Russian legislature in 1997. The process of passing the bill proved lengthier than expected, however, and President Yeltsin did not sign the bill until May 1999.<sup>81</sup>

The recently adopted law “On Grants (Assistance) to the Russian Federation” provides for considerable tax exemptions.<sup>82</sup> One provision of the new law that deserves special mention is a retroactive amnesty on all taxes, exempt under the new law, that have not been paid (the law does not provide for reimbursement of taxes that had been paid). From the US point of view, however, considerable shortcomings continue to exist. Specifically, salaries paid by subcontractors are taxable (as personal income), and the employer is still required to pay payroll taxes (such as payments to the pension fund, medical insurance, etc.). Subcontractors are required to pay the value added tax, which can afterwards be reimbursed. Implementation procedures for the law have also not yet been developed or put into effect, and might require excessive paperwork.

The tax issue is likely to remain contentious, although Russian officials with responsibility for the CTR program recognize that assistance should not be taxed.<sup>83</sup>

The Russian state, however, is in dire need of revenues, which means that attempts to extract taxes are likely to continue.

Recently, the privileges granted to CTR personnel emerged as a problem during negotiations on the extension of the 1992 umbrella agreement in Russia. According to that agreement, personnel involved in CTR activities enjoy only the same privileges as technical and administrative personnel under the Vienna Convention, but the United States asked that these be expanded to the scope of privileges accorded to diplomatic personnel, including full immunity from prosecution. The Russian side refused to grant such extensive privileges, and the Protocol signed on June 15 and 16, 1999, essentially confirmed the 1992 agreement on the issue of privileges. This did not close the issue, however, and privileges remain on the negotiating table. The Russian side continues to insist that only employees of the US government should be accorded diplomatic immunity, while employees of private contractors will not have such far-reaching immunity.

While taxation and immunity issues have never prevented a CTR project from going forward, they nevertheless remain nettlesome issues that drain time and energy from the implementation of the program and undermine some of the trust that has developed on both sides. If the Russian government produces clear and efficient implementation procedures for the new law on assistance, then the problem of taxation may finally be resolved. If, as now appears to be the case, these procedures are cumbersome and bureaucratic, then the result will be wasted time and further project delays.

### **Environmental Concerns and Regional Governments**

A relatively new bureaucratic and administrative problem for the CTR program is the increasing role of local authorities. Their main interests seem to be levying local taxes on CTR-related activities and trying to obtain other profits. For example, in Votkinsk the city administration requested retroactive compensation for lost revenues from agricultural use of the site designated for the solid-rocket elimination facility, including for the period before the facility was even planned, even though the land had not been used for agricultural purposes.

The power of environmental groups, whether working with or against regional governments, also deserves notice. Given the complex technologies and the highly toxic nature of some of the materials involved in the elimination process, the environmental concerns of local residents must be taken seriously and addressed in as open and direct a manner as possible. For those facilities that are already planned or under construction, the CTR office must work closely with the Russian government, local governments, contractors, and Russian non-governmental organizations in order to facilitate an open and informed dialogue on environmental issues. Relying upon local governments to “sell” projects may not work, particularly since some politicians may play upon popular apprehensions so they can make additional demands for funding and compensation.

Therefore, we recommend that the CTR program step up its efforts to explain projects directly to local residents and governments, rather than relying upon contractors and their representatives. The CTR program should consider creating a small office to develop materials for dissemination in Russia and Ukraine that explain the technical approaches and safety considerations of specific projects. Furthermore, CTR managers and their contractors should be encouraged to engage in activities aimed at explaining their projects to local residents, even before possible opposition arises.

### **Funding and Sustainability**

The future of the CTR program depends on domestic and international politics, including, but not limited to whether the United States continues to provide funding. The fact that the program is in the national interest of all countries involved does not mean that the program is immune to other concerns. This has been particularly true for US-Russian relations.

The CTR program is now at an advanced stage involving expensive, multi-year programs that cannot be easily terminated. For example, facilities for solid-fuel rocket motor elimination require at least three to four years of sustained commitment; the recently completed liquid-propellant conversion facilities will need warranty servicing for years to come. Unlike equipment deliveries, these and similar projects demand continued funding; Russia will not be able to support them if funding is suddenly reduced or terminated.

Even with constant funding, plans must be made for ensuring that the dismantlement infrastructure is sustainable over the long term. The Russians cannot replace some critical elements of equipment—e.g., converters for liquid propellant, as well as probably converter facilities in their entirety—at least not yet. Some items are under warranty for up to seven years, but once their warranty is over, Russia will have to eliminate these facilities, develop its own technologies replicating or fitting the American ones, or buy necessary replacements. Consequently, after a period of three to seven years, the whole infrastructure the United States is now creating might become unusable, a liability rather than a boon. This problem is partially alleviated by the fact that the United States is transferring not only equipment, but also relevant technology; hopefully, with time Russia will have enough resources to utilize it to build its own replacement equipment, but how soon this can happen remains unclear.

Overall, however, the CTR program is clearly vulnerable to possible fluctuations in levels of funding that could be caused by unrelated political developments.

### **Creeping Missions and Slippery Slopes**

The original expectations for the CTR program—provision of money and equipment to *facilitate* weapons elimination—turned into a considerably more massive endeavor: *creating* the infrastructure for elimination, disposal, and safe storage and transportation of nuclear weapons, materials, and delivery vehicles. To a significant extent, the United States is now creating what the Soviet Union failed to build. In so doing, the CTR mission has expanded from assisting the elimination of weapons as required by START to the disposal of weapons and materials. This “mission creep” has taken place primarily in such environmentally sensitive areas as elimination of submarines, disposal of reactor cores, disposal of liquid fuel, elimination of solid-fuel motors, and storage of fissile materials. This expansion was perhaps inevitable because one cannot eliminate, for example, SLBMs and leave the problem of liquid propellant aside. Russia did not have a way to dispose of it and this would have prevented, or at least delayed, elimination of SLBMs in the first place.

While most CTR projects are now established, and further mission expansion (with the possible exception of nuclear submarine [SSN] dismantlement) is unlikely, there is another form of expansion taking place. The ini-

tial CTR focus was on providing equipment and facilities for elimination and disposal; now CTR funds are increasingly being used to provide what might be termed “support services.” In some cases a pattern appears evident: a facility is built, but then cannot be put into operation because of infrastructure shortcomings, or transportation costs, or support costs, and the CTR program is then expected to pay these additional costs of operation. Faced with the choice between an idle facility leading to a failed project, or some relatively small additional expenditures, the CTR program has tended to agree to these requests. This “slippery slope” has resulted in CTR funding most of the operating costs of the SS-18 defueling at Surovatikha and for the transportation of nuclear warheads to dismantlement facilities, as well as to discussions about covering transportation costs for quick-fix and other physical protection upgrades.<sup>84</sup> These costs may be justified, and perhaps inevitable, but they point to the leverage that Russia has gained over some projects.

Furthermore, the CTR program is becoming the funding source of first resort, rather than last resort, for many of these support activities. Our interviews reveal that whenever a problem emerges, Russian officials tend to look to the United States first without even considering whether it can be resolved by Russia itself. A similar problem exists in Ukraine, in particular with conversion of enterprises. However, since there are fewer enterprises related to the strategic weapons infrastructure in Ukraine and since elimination of weapons is “final,” this problem is less serious.

To the extent that this trend towards increased funding reflects the shared interests of Russia and the United States, some further expansion to include operating costs may be justified. Indeed, to avoid surprises, such costs may need to be included in project cost estimates. However, if the CTR program appears to be funding operational tasks and projects, and thereby freeing funds for a Russian military buildup, the program could become politically untenable. This points to one of the strongest critiques of the program: that it allows Russia to maintain and even modernize its strategic forces by freeing up funding.

### **Fungible Funds and Strategic Modernization**

Does the CTR program provide funding that frees Russia to allocate funds for strategic forces modernization? Based on trends in Russian strategic moderniza-

tion in the 1990s one thing is clear: if the Russian military and government face the choice between spending money for modernization, or spending on elimination, the latter task is likely to be relegated to second place. It is highly unlikely that weapons elimination activities, and WPC&A will receive more than leftovers from other programs. In terms of domestic politics, a switch from modernization to elimination cannot be “sold” to the public or political elite because national security is traditionally the central concern and responsibility of any government. In Russia, nuclear weapons are the centerpiece of security guarantees. The combination of CTR-funded weapons elimination and Russian-funded strategic modernization is part of the deal that makes implementation of START I possible, and ratification of START II conceivable. Without CTR funding this package deal would collapse, and the future of arms control would be even more uncertain than it is today.

Indeed, the need for sustained CTR funding over the next seven years depends primarily on whether START II enters into force. While the newly elected State Duma may be more favorably disposed towards the treaty, it may still be ratified with conditions (including US Senate action on Theater Missile Defense [TMD] demarcation agreements) that could significantly delay, or even prevent, its entry into force. Should the treaty not be ratified some drawdown in Russian nuclear forces due to age and obsolescence seems inevitable, albeit at a slower rate. The elimination infrastructure, and continued CTR funding, would still be necessary, but the volume of work would be significantly reduced.<sup>85</sup> On the other hand, Russia is arguing for even deeper reductions under START III, so the volume of work could increase if an agreement is reached. Planning needs to take into account this uncertainty, which probably will not be fully resolved until after the elections cycle in both countries is over.

The other political issues that could affect the CTR program are the Anti-Ballistic Missile (ABM) Treaty and tactical nuclear weapons. A US move to withdraw from the treaty could lead to a Russian decision to maintain and enhance its MIRVed missiles,<sup>86</sup> resulting in a new round of arms racing and confrontation. The CTR program would seem to be politically untenable in both countries in this circumstance. Similarly, a Russian decision to revise some of its current policies, for example to restore forward deployment of tactical nuclear weapons, could lead to the United

States questioning the value of the CTR program and the WPC&A project in particular.

If such breaches of the current arms control regime do not take place, the future of the CTR program looks bright. Even during the tensions over Kosovo in spring 1999 the CTR program continued without serious difficulties—testimony to the importance, and apolitical approach, of the program.

## RECOMMENDATIONS AND CONCLUSION

The SOAE and WPC&A projects have been relatively successful and we see no need for a shift in objective or any substantial change in their operation. Our recommendations are tailored towards increasing efficiency rather than reorienting the program.

The Strategic Offensive Arms Elimination project has been very successful in Kazakhstan, and largely successful in Ukraine, but is encountering some delays in Russia. We therefore recommend the following:

- Since several projects are delayed by local and environmental opposition, the CTR program should work closely with the local population and local and regional governments in order to address concerns about facilities and operations. In cases where environmental objections remain strong, the CTR program should consider, jointly with the Russian government, forming an external review committee to independently assess environmental risks.
- Given the significant technological uncertainties and the potential for an expensive duplication of effort, an expert evaluation of solid-fuel disposition options should be commissioned. This evaluation should determine whether the technologies available are safe and efficient, and whether this task could be consolidated at fewer sites in Russia and Ukraine.
- There appears to be a proliferation risk from the sale of potentially useful “scrap” from dismantled missiles. Sensitive components removed from missiles should be strictly accounted for and either destroyed in a verifiable manner or purchased by the United States for later destruction.
- The use of fixed-price contracts should be extended wherever possible, with more extensive use of Russian general contractors and subcontractors.
- Given the tendency for additional, unplanned costs to emerge, US planners should take into account possible “external” costs at the beginning of a project (e.g.

maintenance, operation, and infrastructure costs) and either explicitly include these in the projected budget or make it clear that the United States will not pay for these costs.

- The US and Russian governments must raise the priority given to resolving ongoing taxation problems, especially implementation regulations. These problems threaten to undermine a wide range of US assistance programs in Russia. Taxation issues should be resolved to allow minimum interference with the program and low administrative overhead.
- The Russian government should be encouraged to re-examine the organizational structure created for CTR implementation with a view to streamlining it and uniting planning and implementation functions.
- Since Belarus is no longer participating in the CTR program, but retains liquid fuel on its territory, the United States should encourage Russia to convert this fuel to other products after Russian fuel is converted.

The weapons protection, control, and accounting project faces some of the greatest challenges of the entire CTR program. While it is impossible to independently assess the level of physical protection at Russian nuclear weapon storage sites, all indications are that further upgrades, and repairs, are urgently needed. Given ongoing difficulties with access and transparency, US funding to repair aging storage bunkers may not be feasible. At the very least, however, the questions of whether such repairs are necessary, how much they might cost, and how they would be verified, should be addressed. Given the importance of protecting Russian nuclear weapons, we recommend that this project be given the highest priority within the CTR program. As specific priorities, we recommend:

- The United States and Russia should rapidly agree on the provision of WPC&A upgrades to the 123 nuclear weapon storage sites selected by the Russian government. Priority should be given to former service-level sites, and sites near operational bases.
- Transparency measures should be adequate to ensure that priority sites are getting the WPC&A upgrades in a timely fashion and that they are being installed. The use of “trusted agents” may have to be expanded to allow sufficient monitoring.
- The Security Assessment and Training Center should be put into full operation as soon as possible, with a review of its effectiveness to be conducted after its first year.

- Given the risks associated with the insider threat, both the SATC and the overall program should emphasize assistance to the Personnel Reliability Program. The 12<sup>th</sup> Main Directorate should be encouraged to develop additional proposals for strengthening its Personnel Reliability Program with US assistance.
- The Russian Ministry of Defense should be encouraged to develop a program of realistic inspections and tests of nuclear weapons storage site security that would allow independent verification of the state of security. Part of the cost for the establishment of such a program could be underwritten through the SATC.
- Consideration should be given to funding repair of aging Russian storage sites, if repairs can be conducted in a transparent manner.
- For substantial progress on WPC&A issues to be made, the issues of accounting and transparency must be resolved. We recommend that this issue be given high-level attention by both governments, at the secretary and minister of defense level. Flexibility on both sides will be required if these WPC&A projects are to be successful.

Finally, the threat that is being reduced is a global one and therefore there should be wider participation in this effort on the part of Western states. While both the United Kingdom and France have provided some limited WPC&A assistance in the past, the overall contribution of other countries remains small compared to that of the United States. These two states should be encouraged to provide further assistance with WPC&A projects.

Given the complexity of the task facing the CTR program, the progress that has been made is impressive. Over the next two to three years, the focus of the program will increasingly shift to Russia, as the Ukrainian projects are completed. This tighter focus may help increase the effectiveness of the program, but may also leave it more vulnerable to shifting US-Russian relations. If the CTR program can move forward with delayed projects such as the Votkinsk plant, resolve access and transparency issues concerning WPC&A, and maintain progress in other areas, then it will have laid a firm basis for the successful completion of its mission.<sup>87</sup>

<sup>1</sup> For a history of the Nunn-Lugar legislation see Richard Combs, "US Domestic Politics and the Nunn-Lugar Program," in John M. Shields and William C. Potter, eds., *Dismantling the Cold War: US and NIS Perspectives on the Nunn-Lugar Cooperative Threat Reduction Program* (Cambridge,

MA: MIT Press, 1997), pp. 41-60.

<sup>2</sup> National Defense Authorization Act for Fiscal Year 1994, H.R. 2401, Title XII, "Cooperative Threat Reduction with States of Former Soviet Union," Section 1203.

<sup>3</sup> Dmitri Litovkin, "Sotrudnichestvo 12 glavnogo upraleniya ministerstva oborony RF i ministerstva oborony SShA po programme sovместnogo umensheniya ugrozy" (Cooperation Between the 12<sup>th</sup> Main Department of the RF Ministry of Defense and the US Department of Defense under the Cooperative Threat Reduction Program), in Ivan Safranchuk, ed., *Programma sovместnogo umensheniya ugrozy; otsenka effektivnosti i perspektivy razvitiya*, PIR Center Nauchnyye Zapiski (Research Notes) No. 13, 2000, p. 15.

<sup>4</sup> The SOAE project includes the elimination of ballistic missile submarines (SSBNs) in its budget. The SSBN elimination project is considered in James Clay Moltz, "Russian Nuclear Submarine Dismantlement and the Naval Fuel Cycle," *The Nonproliferation Review* 7 (Spring 2000). Fiscal Year (FY 2000) budget figures are from Brigadier General (Ret.) Thomas Kuenning, "Cooperative Threat Reduction Program: Overview and Lessons Learned," presentation at the CNS Assessing US Dismantlement and Nonproliferation Assistance Programs in the Newly Independent States conference, Monterey, California, December 11-13, 1999, p. 6.

<sup>5</sup> For details of the early history of the CTR program in Belarus, see Vyacheslau Paznyak, "Nunn-Lugar Program Assessment: The Case of Belarus," in Shields and Potter, eds., *Dismantling the Cold War*, pp. 167-192.

<sup>6</sup> See "Belarus: Nuclear Weapons: Launcher Dismantlement" in the Center for Nonproliferation Studies NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/belarus/weapons/issues.htm>>. See also "Belarus Leaders Slam US for Breaking Commitments," *Belapan*, November 3, 1999, in FBIS document FTS19991103001583.

<sup>7</sup> "Ukraine: Nuclear Weapons: Missile and Silo Dismantlement," in the NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/ukraine/weapons/mslsilo.htm>>; and Volodymyr Chumak and Serhey Galakha, "Programma Nann-Lugara V Ukraine" (Nunn-Lugar Program in Ukraine), unpublished paper, Kiev, October 1999.

<sup>8</sup> See "Ukraine: Nuclear Weapons: Bomber Decommissioning/Transfer Developments," in the NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/ukraine/weapons/hvybomr.htm>>, and Sasha Pursley, "Overview: Ukraine's Heavy Bombers," in the NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/ukraine/weapons/bombers.htm>>.

<sup>9</sup> Kuenning, "Cooperative Threat Reduction Program," p. 21.

<sup>10</sup> These estimates for Russia are derived from aggregate figures and may not be completely accurate. For the aggregate figures see Kuenning, "Cooperative Threat Reduction Program," p. 34.

<sup>11</sup> For a detailed discussion of the early years of the CTR program in Russia see Alexander Pikayev, "The CTR Program and Russia: Is a New Start Possible?" in Shields and Potter, eds., *Dismantling the Cold War*, pp. 103-140.

<sup>12</sup> Judith Miller, "US and Russia Extend Deal Reducing Threat from Arms," *New York Times*, June 17, 1999, p. A17.

<sup>13</sup> Kuenning, "Cooperative Threat Reduction Program," p. 6. The SOAE counterpart in Ukraine is called Strategic Nuclear Arms Elimination.

<sup>14</sup> *Ibid.*, p. 34.

<sup>15</sup> *Ibid.*

<sup>16</sup> "Dismantling Nuclear Delivery Vehicles and their Fuel: Some Institutional Aspects," CNS Background Paper, December 1999, p. 1. For details on the engines using these chemicals and their properties see "N2O4/UDMH," *Mark Wade's Encyclopedia Astronautica*, June 10, 1999, <<http://www.rocketry.com/mwade/props/n2o4udmh.htm>>.

<sup>17</sup> The 100,000 MT figure is from Vladimir Sereda, "Salvaging Rocket Fuel Components," *Vooruzheniye, Politika, Konversiya*, February 1, 1997, pp. 37-41, in FBIS document FTS19980823000642. Major General Sereda was responsible for liquid-fuel disposition work in the Ministry of Defense, so this may be considered an official estimate. Presumably it includes fuel removed from SS-18 missiles transferred from Kazakhstan. Sereda estimates that this will increase to 120,000 MT by 2000. A contemporaneous source gives the 120,000 MT figure, although it is unclear whether it refers to current or projected fuel in storage. See Natalya Vdovina, "120 Tysyach toni

smertelnogo yada," *Rossiyskiye Vesti*, February 21, 1997, p. 2, in FBIS-TAC-97-008 (February 21 1997). Vdovina claims that an additional 22,000 MT would be removed from missiles by 2005.

<sup>18</sup> Powerpoint Slides Printed from DOD CTR Program Overview Briefing, January 20, 1999, p. 12.

<sup>19</sup> "Dismantling Nuclear Delivery Vehicles," p. 2; Vdovina, "120 Tsyakh toni smertelnogo yada"; Lilya Guseva, "It is Planned to Build Missile Dismantling Facilities," *Finansovyye Izvestiya*, January 29, 1998, p. 2, in FBIS-TAC-98-033 (February 2, 1998).

<sup>20</sup> For details of Russian plans and technologies for fuel and oxidizer disposition see Sereda, "Salvaging Rocket Fuel Components." Oxidizer conversion to nitric acid will be carried out under a contract awarded to Bechtel National Incorporated on July 27, 1999. A total of 523,000 MT of oxidizer is to be converted to nitric acid by 2004. The nitric acid may, in turn, be used to create fertilizer. See "Bechtel Wins Soviet Missile Dismantlement Contracts," *Post-Soviet States & Eastern Europe Monitor*, August 9, 1999, p. 8, and "Bechtel National, Inc. Wins Two More Cooperative Threat Reduction Contracts," July 27, 1999, <<http://www.bechtel.com/whatnew/1999artsQ3.html>>.

<sup>21</sup> One report indicates that scrap metal from the missiles is used by officers at the facility to fabricate everything from garages to flower pots. One missile can yield "several kilograms of gold and platinum," however, which is presumably not distributed among the junior officers. "Russian TV Reports on Nuclear Missile Destruction Base," broadcast on "Segodnya," NTV (Moscow), August 2, 1998, in FBIS-TAC-98-219, (August 7, 1998).

<sup>22</sup> Additional liquid-fuel elimination facilities are to be built at Aleysk, Dombrovski, and Kartaly. Kuenning, "Cooperative Threat Reduction Program," p. 10.

<sup>23</sup> Sereda, "Salvaging Rocket Fuel Components."

<sup>24</sup> Pavel Felgengauer, "Spisannyye rakety—tozhe oruzhiye," *Segodnya*, April 15, 1998, p. 1. Felgengauer notes that 50,000 MT of heptyl must be converted.

<sup>25</sup> The number of motors to be eliminated may be greater, as the 916 number does not include the upper stages of the SS-N-20 SLBM or the first two stages of the SS-19 ICBM. These motors are not included due to Russian concerns over preserving the secrecy of the propellant mix for these stages. CNS correspondence with CTR contractor, June 2, 1999.

<sup>26</sup> Olga Yakovleva, "Perm—raketnoye kladbishche Rossii?" *Zvezda*, October 1, 1996, p. 12, in *Oborona i Bezopasnost*, December 16, 1996, pp. 3-4.

<sup>27</sup> Ibid. According to one report, an accident at the plant in the 1980s while testing a motor resulted in eight deaths. See Aleksandr Lebedinskiy, "Dazhe detey pugayut amerikanskiye proyekty demontazha russkikh raket," *Pravda*, February 4, 1997, p. 1.

<sup>28</sup> "Dismantling Nuclear Delivery Vehicles," pp. 9-11.

<sup>29</sup> Boris Bronshteyn, "Zhiteli Votkinska protiv utilizatsii raket," *Izvestiya*, January 19, 1999, <<http://www.online.ru/rproducts/izvestia-izvestia-year/19-Jan-99/8.rhtml>>.

<sup>30</sup> CNS interview with Russian defense analyst, October 1999.

<sup>31</sup> Vasilii Lata, "Programma Sovmestnogo umensheniya ugrozy I budushcheye Rakenykh voysk strategicheskogo naznacheniya Rossii," in Safranchuk, ed., *Programma sovmejnogo umensheniya ugrozy*.

<sup>32</sup> While there are 130 silos, the fuel was removed from only 111 missiles. Part of the discrepancy is due to the transfer of 10 ICBMs to Russia in 1995. US Department of Defense, "Cooperative Threat Reduction: Ukraine," briefing materials, August 10, 1998, p. 10.

<sup>33</sup> See Sergey Zgurets, "Raketnyye `voyny` mestnogo masshtaba," *Den* (Kiev), December 9, 1999, <<http://www.day.kieve.ua/rus/1999/228/1-page/1p2.htm>>, also available in English at <<http://www.day.kiev.ua/DIGEST/1999/47/den-ukr/du8.htm>>.

<sup>34</sup> Chumak and Galakha, "Nunn-Lugar Programs in Ukraine," p. 3. General Mikhyuk noted that the revenues were being used for housing purposes. Presentation at the Assessing US Dismantlement and Nonproliferation Assistance Programs in the Newly Independent States conference.

<sup>35</sup> Chumak and Galakha, "Nunn-Lugar Programs in Ukraine," p. 15.

<sup>36</sup> The original price tag for building the plant in Perm was \$54 million. See "Russia: Foreign Assistance: CR Program in Russia: CTR Program Destruction and Dismantlement," NIS Nuclear Profiles Database, <[\[cns.miis.edu/db/nisprofs/russia/forasst/ctr/destruct.htm\]\(http://cns.miis.edu/db/nisprofs/russia/forasst/ctr/destruct.htm\)>. The MOPs project cost is reported in "Bechtel National, Inc. Wins Two More Cooperative Threat Reduction Contracts."](http://</a></p>
</div>
<div data-bbox=)

<sup>37</sup> While similar techniques have been used in the United States, there have been claims that the deteriorating state of Russian missiles, their unique propellant composition, and other factors may pose technical obstacles to both processes.

<sup>38</sup> See Vladimir Orlov and William C. Potter, "The Mystery of the Sunken Gyros," *Bulletin of the Atomic Scientists* 54 (November/December 1998), <<http://cns.miis.edu/research/gyro/index.htm>>. The gyros were shipped to Iraq in 1995, but it is unclear when the missiles were dismantled.

<sup>39</sup> CNS interview with CTR personnel, October 1999.

<sup>40</sup> Chumak and Galakha, "Nunn-Lugar Programs in Ukraine," pp. 6-7.

<sup>41</sup> For a Russian perspective on the success of these early projects see Evgenii P. Maslin, "Russian-US Cooperation on Nuclear Weapons Safety," in Shields and Potter, eds., *Dismantling the Cold War*, pp. 141-150.

<sup>42</sup> According to a Russian source one container has not been delivered; according to US sources, all containers have been delivered. CNS interviews with Russian officials, October 1999. The United Kingdom delivered 150 containers for the same purposes. "Russia: Foreign Assistance: Other International Assistance Programs," NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/russia/forasst/intnatl/intnatl.htm#UK>>.

<sup>43</sup> Ministry of Defense and Russian Aviation and Space Agency officials, author interviews.

<sup>44</sup> Joshua Handler, "Lifting the lid on Russia's nuclear weapon storage," *Jane's Intelligence Review*, August 1999, p. 20.

<sup>45</sup> Ibid., p. 22. For a more detailed accounting see Joshua Handler, "Russian Nuclear Warhead Dismantlement Rates and Storage Site Capacity: Implications for the Implementation of START II and De-alerting Initiatives," Princeton University Center for Energy and Environmental Studies (CEES) Report No. AC-99-01, February 1999.

<sup>46</sup> Igor Valynkin, "My sdelayem vse, chtoby novozemelovskoye ChP ne povtorilos," *Yadernyy kontrol*, November-December 1998, pp. 42-43; Russian Public TV, First Channel, "General Says Nuclear Weapons are Safe," October 9, 1998, in FBIS-TAC-98-282 (October 9, 1998).

<sup>47</sup> Valynkin, "My sdelayem vse."

<sup>48</sup> Alexander Volf, "Armiya v Durmane," *Nezavisimaya gazeta*, May 21, 1999, p. 2.

<sup>49</sup> These reports are summarized in "Russia: Naval Reactors: Nuclear Fleets: Northern Fleet General Developments," NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/russia/naval/nucflt/norflt/norflgen.htm>>.

<sup>50</sup> Viktor Baranets and Aleksey Manzovka, "Whom Are the Strategic Enrichment Missile Troops Defending?" *Komsomolskaya pravda*, October 20, 1998, p. 1, in FBIS-UMA-98-293 (October 20, 1998); Oleg Odnokolenko, "Idet vojna protsessualnaya," *Segodnya*, January 11, 2000, p. 4, in WPS *Oborona i Bezopasnost*, January 14, 2000; Igor Korotchenko, "Reassignments to the Nuclear Commander-in-Chief's Post: Who of the Two Contenders Will Head the Russian Army's Most Secret Structure?" *Nezavisimaya gazeta*, May 21, 1997, p. 1, in FBIS document FTS19970623001601.

<sup>51</sup> Another indicator of concern is that according to official Russian military figures the suicide rate among 12<sup>th</sup> Main Directorate troops is higher than average. See Oleg Falichev, "Discipline is the Foundation of Combat Readiness, Strengthening that Discipline Is the Most Important Component of Army and Navy Reform," *Krasnaya zvezda*, in FBIS Document FTS19980311000841.

<sup>52</sup> US Department of Defense, "Nuclear Weapons Security Assessment and Training Center Opens," press release, November 1, 1999, <<http://www.defenselink.mil>>. The total is through the end of FY 1999. For details on earlier US assistance in this area see Maslin, "Russian-US Cooperation on Nuclear Weapons Safety."

<sup>53</sup> CTR Program Overview Briefing, January 20, 1999, p. 24.

<sup>54</sup> The facility cost approximately \$8 million. See "Russia: Foreign Assistance: CTR Details: Demilitarization: WPC&A," in the NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/russia/forasst/ctr/projdev/WPC&A.htm>>. See also US Department of Defense, "Nuclear Weapons Security Assessment and Training Center Opens," and Andrew Koch, "USA, Russia open joint training centre," *Jane's Defence Weekly*, November 3,

1999, in Lexis-Nexis Universe, <<http://web.lexis-nexis.com>>.

<sup>55</sup> CTR Program Overview Briefing, January 20, 1999, p. 26.

<sup>56</sup> "Rossiya poluchila ot SshA na obespecheniye yadernoy bezopasnosti svyshe \$80 mln-nachalnik upravleniya minoborony," Interfax, February 3, 1999, and Yuriy Golotyuk, "American Lie Detector Will Safeguard Our Warheads' Security," *Izvestiya*, February 4, 1999, in FBIS Document FTS19990204000906. While this figure is attributed to General Valynkin, the head of the 12<sup>th</sup> Main Directorate, the transcript of the General's news conference does not include this number. "Press Conference with Colonel General Igor Valynkin, Chief of the Defense Ministry Main Directorate on Nuclear Safety February 03, 1999," Official Kremlin International News Broadcast, Federal Information Systems Corporation, <<http://web.lexis-nexis.com>>, February 4, 1999.

<sup>57</sup> CTR Program Overview Briefing, January 20, 1999, p. 33.

<sup>58</sup> In many respects, this problem of determining whether equipment is properly used after installation is very similar to that encountered in the materials protection, control, and accounting program. See Emily Ewell Daughtry and Fred L. Wehling, "Cooperative Efforts to Secure Fissile Material in the NIS," *The Nonproliferation Review* 7 (Spring 2000).

<sup>59</sup> CNS interviews with CTR program personnel, October and December 1999.

<sup>60</sup> This is consistent with the fact that the quick-fix program was instituted before the 12<sup>th</sup> Main Directorate took control over all nuclear storage sites in 1998.

<sup>61</sup> CNS interviews with Russian military analysts, April 1999, January 2000.

<sup>62</sup> "DOD News Briefing: General Eugene Habinger, Commander of US Strategic Command," June 16, 1998, <<http://www.defenselink.mil>>. Lieutenant General Vasily Lata, Presentation at the CNS conference on Assessing US Dismantlement and Nonproliferation Assistance Programs in the Newly Independent States, Monterey, California, December 11-13, 1999. See also the presentation at this conference by Valeriy Semin, "ETRI and Future Funding issues: Russian Perspective."

<sup>63</sup> Combs, "US Domestic Politics and the Nunn-Lugar Program," pp. 50-51.

<sup>64</sup> PIR Newline, February/March 1999, p. 2.

<sup>65</sup> CNS interview with former US nuclear security inspector, December 1999.

<sup>66</sup> There are reports of simulated attacks by special forces against nuclear weapons storage sites. General Habiger observed such an exercise during his visit to the Saratov national-level nuclear weapons storage facility. Such "exercises" are usually rehearsed well in advance of the actual demonstration. Whether there are authorized "insiders" who attempt to evade or manipulate the system is a separate, and more sensitive, question. See "DOD News Briefing: General Eugene Habiger, Commander of US Strategic Command," June 16, 1998, <<http://www.defenselink.mil>>.

<sup>67</sup> This list is from John M. Shields and William C. Potter, "Cooperative Assistance: Lessons Learned and Directions for the Future," in Shields and Potter, eds., *Dismantling the Cold War*, pp. 389-390.

<sup>68</sup> This assessment has not evaluated the work on the Mayak Fissile Material Storage Facility, which has proven to be one of the more complicated and trouble-prone CTR program projects.

<sup>69</sup> See Chumak and Galakha, "Nunn-Lugar Programs in Ukraine," pp. 5-7.

<sup>70</sup> For an incisive study of bureaucratic interests in the early phase of the CTR program see Alexander Pikayev, "The CTR Program and Russia." Subsequent reorganizations are analyzed in "Dismantling Nuclear Delivery Vehicles and Their Fuel: Some Institutional Aspects," and Ivan Safranchuk, "Realizatsiya programmy likvidatsii strategicheskikh nastupatelnykh vooruzheniy v Rossii: dostizheniya i problemy," in Safranchuk, ed., *Programma sovmejnogo ymensheniya ugrozy*.

<sup>71</sup> Ministry of Defense and Russian Aviation and Space Agency officials, author interviews.

<sup>72</sup> Safranchuk, "Realizatsiya programmy," pp. 28-29.

<sup>73</sup> Ministry of Defense and Russian Aviation and Space Agency officials, author interviews.

<sup>74</sup> See, for example, Pikayev, "The CTR Program in Russia," pp. 130-135.

<sup>75</sup> CNS Interviews with Russian officials, Moscow October 1999. Chumak and Galakha, "Nunn-Lugar Programs in Ukraine," p. 4.

<sup>76</sup> Ministry of Defense and Russian Aviation and Space Agency officials, author interviews.

<sup>77</sup> CNS interviews with CTR personnel, October 1999. See also Kuenning, "Cooperative Threat Reduction Program," p. 31.

<sup>78</sup> CNS interviews with Russian officials, September and October 1999.

<sup>79</sup> The tax-exempt status of CTR funding was implemented by a 1996 inter-governmental agreement that had not been approved by the Russian Duma and did not provide automatic tax exemption for new projects. See "Dismantling Nuclear Delivery Vehicles," pp. 12-13.

<sup>80</sup> See Chumak and Galakha, "Nunn-Lugar Programs in Ukraine." For information on recent attempts by Ukrainian regional authorities to tax CTR projects see "Ukraine: Foreign Nuclear Assistance: CTR Developments" in the NIS Nuclear Profiles Database, <<http://cns.miis.edu/db/nisprofs/ukraine/forasst/fundukr.htm>>. These attempts seem to have been connected to alleged corruption in the Ukrainian distribution of funds to contractors.

<sup>81</sup> For details of the law's passage, see "Dismantling Nuclear Delivery Vehicles," pp. 15-16.

<sup>82</sup> The full title of the law is "On Grants (Assistance) to the Russian Federation, Amendments to Certain Tax Legislations, and Benefits with Respect to Payments to State Extra-Budgetary Funds in Connection with the Provision of Grants (Assistance) to the Russian Federation."

<sup>83</sup> Ministry of Defense and Russian Aviation and Space Agency officials, author interviews.

<sup>84</sup> Perhaps the most significant example of expansion of a project is the US decision to assume almost complete responsibility for funding the Fissile Material Storage Facility.

<sup>85</sup> Estimating the change in reduction is complex, because without the treaty the anticipated Russian force structure could be quite different. However, we estimate that at least 64 silos might not need to be eliminated, as well as at least 102 SLBMs. Fewer ICBMs might also be eliminated, as their service life would be extended.

<sup>86</sup> MIRV stands for multiple independently targetable re-entry vehicles. MIRVed missiles thus have multiple warheads that can be directed to separate targets.

<sup>87</sup> The authors would particularly like to thank Roland Lajoie for comments and suggestions on an earlier version of this paper, and Aleksander Pikayev for providing valuable insights into the implementation of CTR projects in Russia. The questions and comments of many participants at the CNS conference on Assessing US Dismantlement and Nonproliferation Assistance Programs in the Newly Independent States were of great help in preparing the final version of this report, although all responsibility for facts and interpretations lies with the authors.