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Report to Congressional Requesters

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NUCLEAR NONPROLIFERATION

Security of Russia's Nuclear Material Improving; Further Enhancements Needed

GAO-01-312

Contents

Abbreviations

DOE	Department of Energy
GAN	Gosatomnadzor (The Federal Nuclear Radiation Safety Authority)
GAO	General Accounting Office
MINATOM	Ministry of Atomic Energy (Russia)

GAO
Accountability * Integrity * Reliability

United States General Accounting Office
Washington, DC 20548

February 28, 2001

The Honorable John W. Warner
Chairman, Committee on Armed Services
United States Senate

The Honorable Pat Roberts
Chairman, Subcommittee on
Emerging Threats and Capabilities
Committee on Armed Services
United States Senate

Safeguarding nuclear material that can be used in nuclear weapons is a primary national security concern of the United States and Russia. Terrorists and countries seeking nuclear weapons could use as little as 25 kilograms of highly enriched uranium or 8 kilograms of plutonium to build a nuclear weapon. With the dissolution of the Soviet Union, it is estimated that Russia inherited 603 metric tons of highly enriched uranium and plutonium in forms highly attractive to theft. This amount of material is enough to produce almost 40,000 nuclear bombs. The breakdown of Soviet-era control systems, coupled with social and economic deterioration within Russia, has increased the threat of this material's theft or diversion.

Since the early 1990s, the United States has been working cooperatively with Russia to install nuclear security systems at its nuclear sites. In 1995, the Department of Energy (DOE) established the Material Protection, Control, and Accounting program to install improved security systems for nuclear material at civilian nuclear sites, naval fuel sites, and nuclear weapons laboratory sites in Russia.[1,2] As of February 2001, DOE officials had identified 252 buildings at 40 sites in Russia that require nuclear

[1]The National Nuclear Security Administration's Office of Defense Nuclear Nonproliferation manages the Material Protection, Control, and Accounting program. The National Nuclear Security Administration was established by the Congress on March 1, 2000, as a semiautonomous agency within DOE with responsibilities for the nation's nuclear weapons, nuclear nonproliferation activities, and naval reactor programs.

[2]According to DOE, these sites are nuclear facilities that have a guarded perimeter and one or more buildings with weapons-usable nuclear material. In the Russian naval sector, sites include ships used to store nuclear fuel. In the nuclear weapons complex, sites include 10 "nuclear cities" located throughout Russia.

security systems. Through direct contracts between its national laboratories and the Russian sites, DOE provides funding for the security improvements.[3] Project teams consisting of nuclear security experts from the national laboratories work with their Russian counterparts to design and install the improved security systems. In 1998, DOE issued guidelines that provide criteria for effectively reducing the risk of nuclear material theft in Russia.[4] The criteria specify the types of security improvements needed on the basis of threat assessments developed for each of the sites in Russia. By following the criteria, DOE plans to install security systems that reduce the risk of theft as quickly as possible at these sites. While the systems being installed are not as stringent as those in the United States, they are designed to prevent individual employees or a small group of criminals from stealing nuclear material. The Department has established a panel of experts, known as the Technical Survey Team, to determine if the installed systems meet the Department's criteria for effectively reducing the risk of nuclear material theft at a site. The Team conducts its reviews by examining project documentation and meeting with the project team that designed and installed the systems but does not generally visit the Russian sites.

This is the second of two reports we have issued addressing your request to assess DOE's Material Protection, Control, and Accounting program.[5] This report addresses (1) if the nuclear security systems are reducing the risk of theft and how DOE is measuring their effectiveness; (2) what DOE is doing to ensure that Russia operates and maintains the improved security systems over the long run; and (3) DOE's plan for completing the program.

[3]DOE manages 23 national laboratories. Originally created to design and build atomic bombs under the Manhattan Project, these laboratories have since expanded to conduct research in many disciplines—from high-energy physics to advanced computing at facilities throughout the nation. Ten national laboratories participate in the program, including: Argonne, Brookhaven, Lawrence Livermore, Pacific Northwest, Oak Ridge, Los Alamos, Sandia, New Brunswick, Savannah River, and Pantex.

[4]"Guidelines for Material Protection, Control, and Accounting Upgrades at Russian Facilities" (Dec. 1998).

[5]The first report, *Nuclear Nonproliferation: Limited Progress in Improving Nuclear Material Security in Russia and the Newly Independent States* (GAO/RCED/NSIAD-00-82, Mar. 6, 2000), provided information on the cost of the program and how much progress the program had made in installing new nuclear security systems in the former Soviet Union.

Results in Brief

The security systems installed by the Department of Energy are reducing the risk of theft of nuclear material in Russia, but hundreds of metric tons of nuclear material still lack improved security systems, and the Department has no mechanism in place to monitor the effectiveness of the systems once they are installed. As of February 2001, the Department had installed completed or partially completed security systems in 115 buildings protecting about 32 percent of the 603 metric tons of weapons-usable nuclear material identified as being at risk of theft or diversion from Russia. The Department installed completed systems in 81 buildings protecting about 86 metric tons, or about 14 percent, of the nuclear material. The Department has also installed partially completed security systems, known as *rapid upgrades,* in 34 additional buildings protecting about 106 metric tons, or 18 percent, of the nuclear material. According to the Department, the program has work underway on an additional 130 metric tons of nuclear material. The Department's Technical Survey Team found that the majority of the security systems are being installed in a manner that is reducing the risk of nuclear material theft. During our visits to nine sites, we observed, among other things, nuclear material storage vaults equipped with strengthened doors, locks, video surveillance systems, and alarms that can detect and delay thieves as they attempt to steal nuclear material. We also observed instances where systems were not operated properly. For example, at one nuclear facility that we visited, an entrance gate to a building containing nuclear material was left open and unattended by guards. While the Department has made progress in installing security systems at Russian sites, hundreds of metric tons of nuclear material remain unprotected. Because the Russian Ministry of Atomic Energy has restricted the Department's access to some nuclear weapons laboratories and civilian sites, the Department is not installing security systems in 104 buildings containing hundreds of metric tons of material that it has identified as needing improved security systems. While the Technical Survey Team's reports and our visits indicate that the security systems as installed are currently reducing the risk of theft, the Department does not have a system in place to monitor the systems on a long-term basis to ensure that they continue to detect, delay, and respond to attempts to steal nuclear material. The Department is currently collecting from individual sites information that would be useful for such a system. This report recommends the development of a system to monitor the sites to ensure that the security systems are working as designed.

In addition to installing security systems, the Department is providing sites with long-term assistance through equipment warranties, operating procedure development, and training. The Department also has projects under way to help Russia's Ministry of Atomic Energy and nuclear

regulatory authority develop (1) a nuclear material accounting database that will enable Russia to track its total inventory of nuclear material; (2) regulations to ensure effective operations and maintenance of the systems; and (3) an inspection and enforcement system to ensure that sites comply with regulations. In addition, the Department is supporting security improvements for trains and trucks that transport nuclear material between and within sites and for nuclear material security training centers. While some progress has been made on these projects, the Department does not expect them to be completed before 2020. To sustain the improved security systems, the Department estimates that it may have to assist each site for up to 3 years, or possibly longer, after the systems are installed.

In response to our March 2000 report, the Department developed a cost estimate and time frame for completing the Material Protection, Control, and Accounting program. The Department estimated that the total cost of the program through 2020 will be about $2.2 billion. This estimate includes $823.1 million to complete installation of nuclear material security systems by fiscal year 2011, $711.8 million for assistance to Russia to support and operate the security systems through 2020, and $241.3 million for program management. Department officials expressed uncertainty about the cost estimate and time frame for completing the program because of a number of issues that could delay the program or affect its costs. For example, the estimate also includes $387.2 million for consolidating the nuclear material into fewer buildings and converting some of the material into a form that cannot be used for weapons. While this initiative could reduce program costs by reducing the number of buildings needing security systems, the Russian Ministry of Atomic Energy has yet to identify which buildings and sites it plans to close. The Department is currently developing a strategic plan for achieving its goals for reducing the risk of theft in Russia and managing the program's operations. This report recommends that the plan include (1) an estimate of how much assistance is required to sustain the operations of the systems based on an analysis of the costs and the sites' ability to cover these costs and (2) options for completing the program on the basis of the progress made on gaining access to sensitive sites and the closure of buildings and sites.

We presented a draft of this report to the Department. The Department generally agreed with our findings and concurred with our recommendations. The Department also provided technical clarifications, which we incorporated where appropriate.

Background

According to DOE, 603 metric tons of highly enriched uranium and plutonium are at risk of nuclear material theft in Russia. This material, located at civilian research centers, naval fuel storage sites, and Russia's nuclear weapons laboratories, can be used directly in a nuclear weapon without further enrichment or reprocessing. The material is considered to be highly attractive to theft because it (1) is not very radioactive and therefore relatively safe to handle and (2) can easily be carried by one or two people in portable containers or as components from dismantled weapons. The dissolution of the Soviet Union in 1991 and the subsequent social, political, and economic changes in Russia weakened the existing Soviet-era nuclear security systems. These systems placed a heavy emphasis on internal surveillance of nuclear workers and citizens and severe penalties for violations of nuclear security. The decline in economic conditions, late payment of wages to nuclear workers, and the rise of a strong criminal element increased the risk that employees or criminal elements in Russia would attempt to steal nuclear material for economic gain. Furthermore, Russian nuclear facilities lacked modern equipment that could quickly detect, delay, and respond to attempted thefts of nuclear material.

Over the last 7 years, DOE has worked cooperatively with Russia to install modern nuclear security systems consisting of three components:

- Physical protection systems, such as fences around the buildings that contain nuclear material; metal doors protecting the rooms where material is stored; and video surveillance systems that monitor the storage rooms.
- Material control systems, such as seals attached to nuclear material containers that indicate whether material may have been stolen from the containers and badge systems that only allow authorized personnel into areas containing nuclear material.
- Material accounting systems, such as inventories of nuclear material and computerized databases that enable sites to track the amount and type of nuclear material contained in specific buildings.

DOE's Guidelines for Material Protection, Control, and Accounting Upgrades at Russian Facilities provide U.S. project teams with criteria for designing and installing security systems. The criteria were designed to achieve the greatest reduction to the risk of nuclear material theft within the program's projected budget. While the guidelines are based on DOE's physical security and material control and accounting requirements, and the International Atomic Energy Agency's recommendations for physical protection, they are not as stringent as U.S. and international standards used to protect material at similar kinds of sites. According to the

guidelines, installing security systems that use multiple components reduces the risk of theft by minimizing the reliance on any one component to detect and delay attempted thefts. Locating the components close to the material, such as around storage vaults and work areas, rather than at a site's perimeter also reduces risk by minimizing the chance that a thief can bypass security systems and steal material. The guidelines also establish priorities for installing security systems on the basis of how easily the nuclear material being protected could be converted to nuclear weapons. Material that is more readily converted to nuclear weapons receives more extensive security systems than material that poses less of a proliferation risk. DOE is also placing a priority on countering lower-level threats of theft from nonviolent individual employees or a small group of criminals rather than from higher-level threats such as those from violent employees or terrorists equipped with explosives to maximize the amount of material that can be protected within the program's budget.

DOE's Technical Survey Team reviews project documentation and meets with project team members to ensure that the installed systems meet DOE's guidelines for reducing the risk of nuclear material theft in Russia. The Team comprises eight national laboratory personnel with expertise in physical protection systems and material control and accounting for nuclear materials. The Technical Survey Team's reviews include (1) an estimate of the original risk of theft at the site and how the installed security systems will reduce it; (2) the extent to which project activities have reduced the risk of theft at the site, on the basis of completed systems or other risk-reduction activities; and (3) the extent to which the security systems are balanced with appropriate physical security and material control and accounting equipment and procedures. The Team also reviews the project work plans for each site at the beginning of the fiscal year to ensure that project teams are installing systems that are effective and are of the least cost.

DOE Has Reduced the Risk of Theft for 32 Percent of the Nuclear Material in Russia, but Hundreds of Metric Tons of Nuclear Material Still Lack Improved Security Systems

DOE installed completed and partially completed security systems in 115 buildings with about 32 percent of the 603 metric tons of weapons-usable nuclear material. We found that the systems that were installed are reducing the risk of nuclear material theft in Russia. DOE is not installing security systems in 104 buildings because Russia's Ministry of Atomic Energy (MINATOM) has restricted access to buildings containing several hundred metric tons of nuclear material because of Russian national security concerns. DOE currently does not have a system in place to periodically measure the effectiveness of the systems to ensure that they continue to detect, delay, and respond to attempts to steal nuclear material.

Installed Systems Are Reducing the Risk of Theft for 192 Metric Tons of Nuclear Material

As of February 2001, DOE had installed completed and partially completed security systems in 115 buildings with about 192 metric tons, or about 32 percent, of the 603 metric tons of weapons-usable nuclear material. DOE installed completed systems in 81 buildings protecting about 86 metric tons, or about 14 percent, of the nuclear material. DOE has also installed partially completed security systems known as *rapid upgrades* in 34 additional buildings protecting about 106 metric tons, or about 18 percent of the nuclear material. According to DOE, rapid upgrades consist of such things as bricking up windows in storage buildings; installing strengthened doors, locks, and nuclear container seals; establishing controlled access areas around nuclear material; and implementing procedures requiring two people be present when nuclear material is handled. By installing rapid upgrades, DOE helps Russian sites establish basic control over nuclear material while U.S. project teams finish installing the security system. DOE officials consider a system to be completed when it includes such components as electronic sensors, motion detectors, and closed circuit television systems to detect intruders; central alarm stations, where guards can monitor cameras and alarms; and computerized material accounting systems. According to DOE, the program also has work under way on an additional 130 metric tons of nuclear material.

Table 1 shows the number of buildings and types of sites where completed nuclear security systems have been installed, where rapid upgrades have been installed, where work has started but rapid upgrades have not been completed, and where work has not yet started.

Table 1: Status of Nuclear Security System Installations as of February 2001

Status	Buildings at Russian civilian sites	Buildings at Russian naval nuclear fuel sites	Buildings at Russian nuclear weapons laboratories	Total
Completed systems	51	21	9	**81**
Rapid upgrades	8	3	23	**34**
Work started	11	11	46	**68**
No work started	19	1	49	**69**
Total	**89**	**36**	**127**	**252**

Note: The table does not include the status of nuclear security systems installed by DOE at Russian Navy nuclear weapons storage sites. See appendix I for information on DOE's program to install security systems at these sites. See appendix II for information on the status of installed systems at Russian civilian, naval fuel, and nuclear weapons sites.

Source: DOE.

Our assessment that the installed systems are reducing the risk of nuclear material theft is based on the Technical Survey Team's reviews of the security improvements at Russian sites, our visits to nine sites, and our discussions with DOE and Russian officials responsible for installing the systems.

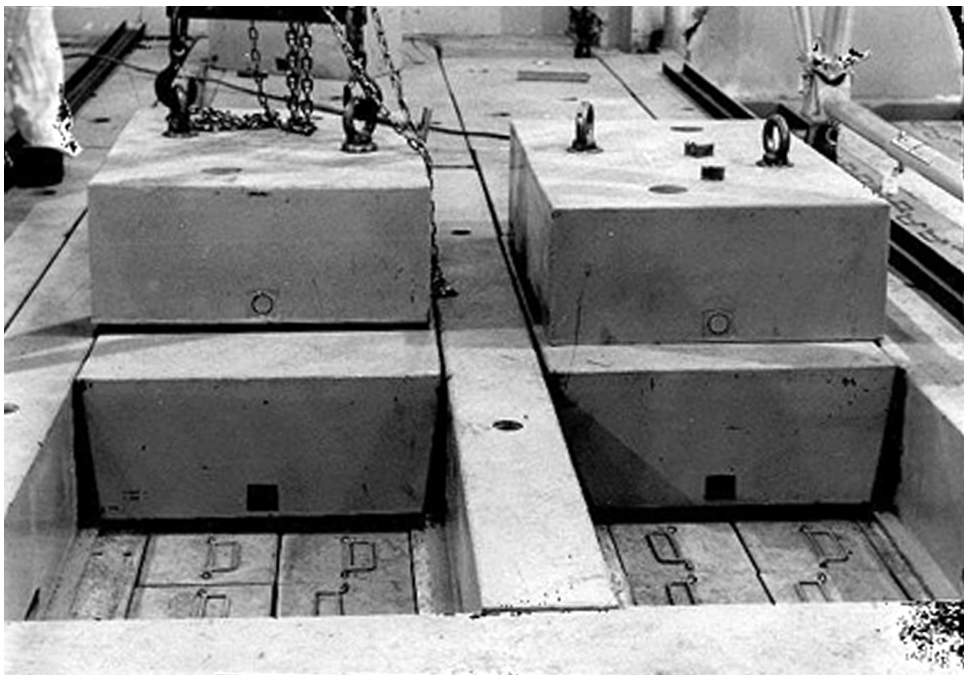
From January 1999 through September 2000, the Technical Survey Team reviewed projects at 30 of the 40 sites with nuclear material in Russia.[6] Of the 30 sites reviewed, the Team found that the security systems installed or being installed for 22 sites are reducing the risk of theft. Specifically, the systems increased the site's ability to detect, delay, and respond to an attempted theft or otherwise strengthened control over their nuclear materials at all times. To evaluate the projects, the Team used DOE's criteria and determined (1) whether the project teams installed security systems on the basis of how easily the nuclear material being protected could be converted to nuclear weapons, (2) whether the systems were installed close to the nuclear material rather than at the sites' perimeter, and (3) whether multiple components were installed to minimize reliance on any one component to prevent theft. The following are examples where

[6]Of the 10 sites not reviewed, 4 were nuclear weapons assembly and disassembly sites where DOE is not currently installing systems because it does not have access to the sites, and 5 were small Russian research sites where systems were installed prior to 1998 when DOE issued its program guidelines for installing systems. DOE does not believe that a Technical Survey Team review for these sites is as high a priority as that for the sites where systems are currently being installed. In addition, as of February 1, 2001, the Team had not completed its review of a Russian Navy fuel site (Site 86).

the Technical Survey Team found that the systems as installed are reducing the risk of nuclear material theft:

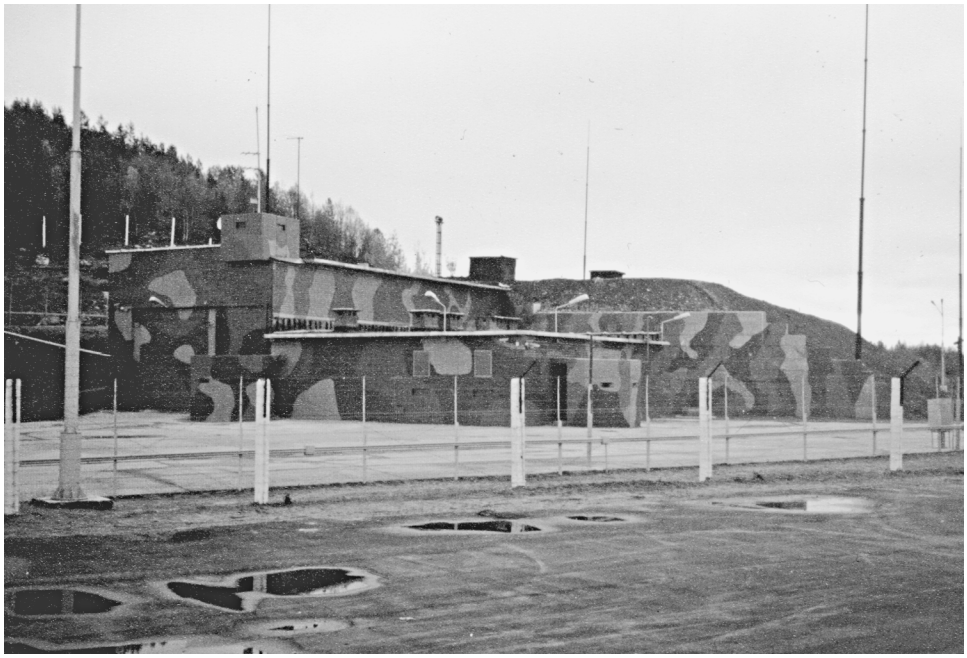
- At the Mayak Production Association, a major producer of plutonium for Russia's nuclear weapons program, DOE installed 1-ton interlocking concrete blocks over trenches containing over 5,000 containers of plutonium. (See fig. 1.) As of February 2001, the blocks were protecting over 15 metric tons of plutonium. Each container has a computerized bar code and tamper-resistant seal to help the site track its location and to show if any attempts have been made to open the container. Each block provides a barrier to delay a thief from gaining access to the material before being detected. In addition, the site's ability to detect and respond to an attempted theft is reinforced with additional sensors, surveillance cameras, alarms, and communications systems. According to the Technical Survey Team, the blocks are effective against an adversary using sophisticated methods.
- At Navy Fuel Storage Sites 49 and 34 (located in Murmansk and Vladivostok, respectively), DOE helped the Russian Navy construct storage complexes to consolidate tens of tons of nuclear reactor fuel that were located in poorly protected sites in the Northern and Pacific Fleets. (Navy Site 49 is shown in fig. 2.) DOE, working with the Russian Navy, strengthened the walls and ceilings of the nuclear storage buildings and installed portal monitors for nuclear material, which scan people and vehicles entering and leaving facilities to ensure that they have not taken nuclear material from storage locations, video surveillance systems, alarms, and fences to increase the ability to detect a theft. In addition, DOE improved the guard forces' ability to respond to an attempted theft by providing them with helmets, bulletproof vests, strengthened barriers that protect against gunfire, and a radio communication system. According to the Technical Survey Team, the systems have significantly reduced the risk of nuclear material theft at these sites.
- At the Institute of Physics and Power Engineering at Obninsk, DOE bricked up windows at several buildings that contain several tons of nuclear material and installed high-security vault doors and locks and access control systems. According to the Technical Survey Team, these measures reduce the risk of theft. The project team also developed an inventory strategy that reduced the time it takes to inventory items and encouraged the facility to place nuclear material that it seldom uses in sealed containers. According to the Team, these security improvements are consistent with the guidelines issued by the program.

Figure 1: Blocks Used to Protect Plutonium at the Mayak Production Association



Source: DOE.

Figure 2: Russian Navy Site 49



Source: Russian Federation Navy.

At six of the eight remaining sites, the Technical Survey Team's reports indicated that activities undertaken to install security systems had achieved little or no risk reduction so far, while at the two remaining sites, it was too soon to tell if the systems were reducing risk. At two of the six sites (the Petersburg Nuclear Physics Institute and the Bochvar Institute), the systems that were installed did not meet the criteria for reducing risk because they were installed at the perimeter of the sites rather than close to the material. DOE's project teams are currently taking actions to correct the problems. At two other sites—Sarov (also known as Arzamas-16, the primary nuclear weapons design laboratory in Russia) and Elektrostal (a MINATOM facility that fabricates reactor fuel rods of highly enriched uranium for the Russian Navy)—project teams did not have sufficient access to buildings to install systems in accordance with the guidelines. At Sarov, the project team gave Sarov personnel security system components to install in some of the buildings where the project team did not have physical access. However, according to the Technical Survey Team, while incremental improvements to security have occurred at Sarov, the risk of nuclear material theft remains high. At Elektrostal, DOE project teams were limited to providing security improvements only for low enriched uranium, which poses a low risk of proliferation if stolen. Because of the

project team's lack of access to buildings with highly enriched uranium, the program has decided not to enter into any new contracts at the site until access issues are resolved. At Tomsk-7, the team did not verify the type of material it was protecting and installed systems around material that, according to the Technical Survey Team, presented little proliferation risk. At the Lytkarino Research Institute of Scientific Instruments, the strengthened doors installed as part of the site's rapid upgrades were ineffective, and according to the Team, needed to be replaced.

In order to observe how the nuclear security systems are reducing the risk of theft in Russia, we visited nine nuclear sites in Russia where DOE installed systems. During our visits, we toured buildings where the installation of nuclear security systems was complete as well as buildings where work was ongoing or had not been started. We also discussed how the nuclear security systems were working with the Russian site officials and U.S. project team members who accompanied us on the tours. We saw site personnel demonstrate how they use the security systems, and we observed the multiple systems designed to detect or delay an outsider or employee attempting to steal material. The officials at the sites that we visited also showed us nuclear material storage rooms as well as rooms where employees work with the material. We observed the following systems and concluded that they were reducing risk:

- Storage vaults equipped with strengthened doors, locks, video surveillance systems, and alarms that can detect and delay thieves as they attempt to steal nuclear material.
- Central alarm stations where guards monitored the video surveillance systems. The guards were equipped with communications equipment to respond to alarms.
- Nuclear material containers equipped with computerized bar codes and tamper-resistant seals that allow site personnel to perform quick inventories of the material and determine whether containers were tampered with.
- Access and exit procedures that ensure that only authorized personnel are allowed into areas with nuclear materials.
- Nuclear material portal monitors that scan people and vehicles entering and leaving facilities to ensure that they have not taken nuclear material from storage locations.

However, at three sites, we also observed some problems that appeared to decrease the effectiveness of the new systems. For example, one site left a gate to its central storage facility open and unattended during the day. (See fig. 3.) According to a site official, the gate is left open to allow

employees to enter and leave the facility without having to use the combination locks on the gate. When the gate is open, the only other controlled access point is at the perimeter of the site. At another site that we toured, the guards did not respond to metal detectors that were set off when we entered the site, nuclear material portal monitors were not working, and alarm systems had exposed cabling that could allow an adversary to cut the cable and disable the alarm easily. At the third site, DOE had provided heavy metal containers that could be bolted to the floor to make it more difficult for an individual to gain access to the material. But some of the containers were empty, and instead, the site stored material in old containers that did not offer as much protection. In addition, this site did not have access controls, such as metal detectors or nuclear material portal monitors at locations where nuclear material is stored, and the guards did not check the identification of people entering the storage areas. More information on the sites that we visited can be found in appendix III.

Figure 3: Gate Left Open and Unattended at a Russian Nuclear Facility

DOE Is Not Installing Systems in Many Buildings Because of Access Problems

As of February 2001, DOE was not installing systems in 104 buildings because the U.S. project teams did not have physical access to the buildings. These buildings, mostly located at Russian nuclear weapons laboratories, contain hundreds of metric tons of nuclear material. According to DOE officials, physical access is needed to (1) confirm the type of material to be protected, (2) design systems that provide adequate security for the material to be protected, (3) ensure that equipment is installed properly, and (4) ensure that the sites operate the systems properly and use equipment for the intended purpose. MINATOM is reluctant to grant DOE project teams physical access to the buildings because of Russian national security concerns and Russian laws on the

protection of state secrets. For example, rather than allow project teams into buildings where they can determine what security systems are needed, some sites have allowed the project teams only to view the site perimeters. Consequently, the project teams do not obtain enough information on the buildings—for example, information on the type of material and how easy it would be to convert the material into a nuclear weapon—which determines the type of security systems that DOE would install. Because it lacked physical access, in September 1999, DOE suspended new work at six of the nuclear weapons laboratories—Sarov, Snezhinsk (also known as Chelyabinsk-70), and the four nuclear weapons assembly and disassembly sites.[7] Table 2 shows the status of DOE's physical access to buildings by program sector.

Table 2: Number of Buildings Where Russia Has Not Granted Physical Access to U.S. Project Teams

	Russian civilian sites	Russian naval nuclear fuel sites	Russian nuclear weapons laboratories	Total
Total number of buildings	89	36	127	**252**
Number of buildings where teams have physical access	78	36	34	**148**
Number of buildings where teams do not have physical access	11	0	93	**104**
Percentage of buildings where teams do not have physical access	12%	0%	73%	**41%**

Source: DOE.

In January 2000, DOE issued new guidance to project teams on access to sites. Under the new guidance, physical access is still the preferred means to identify nuclear material that needs protection and to design and install security systems. However, if the Russian site officials do not grant physical access to the project team, DOE officials may pursue alternative means of providing assurances if the alternatives are acceptable to site officials and DOE approves of the alternative. According to the guidance, alternative means of providing assurances may include a combination of photographs and videotapes of areas before and after the installation of security systems, a visual inspection by a single member of the project team, and written certifications by site directors. Once DOE approves the alternate means for providing assurances, it is incorporated into the access provisions that become part of the contract with the site for installing security systems. According to a DOE official, DOE pays only for

[7]According to a DOE official, work under contracts with the sites prior to September 1999 continues, but no new contracts have been signed.

work performed under the contract once it receives the assurances obtained as stipulated in the access provisions of the contract. DOE officials are currently testing this approach in pilot programs with Sarov and Snezhinsk for work at sensitive buildings at the sites but it has not yet reached any such agreements under the new access guidance.

DOE has also reached a draft agreement with MINATOM to provide program personnel with greater access to sensitive MINATOM sites. This agreement is undergoing interagency review in the executive branch. According to DOE, while some of the more sensitive areas at MINATOM's nuclear facilities may remain inaccessible to program personnel, this agreement will allow the program to further expand its work once it is concluded.

DOE Does Not Have a Mechanism to Assess the Systems' Operational Effectiveness

DOE has not established a means to systematically measure the effectiveness of the security systems that it has installed at Russian nuclear sites. The Technical Survey Team's and our observations provide only a snapshot of how effectively the installed systems are reducing the risk of nuclear material theft in Russia. The new security systems' ability to reduce the risk of theft also depends on whether the site personnel operate the systems on a continuing basis; follow administrative procedures associated with controlling access to material; maintain systems such as alarms, sensors, and television surveillance cameras; and test equipment and procedures periodically.

In 1997, DOE asked Lawrence Livermore National Laboratory to develop measures to determine the systems' effectiveness. Lawrence Livermore ultimately developed a measurement system that looked at 30 elements that make up an effective security system, such as access controls, intrusion detection, the testing of electronic security and alarm systems, and the functioning of the guard forces. The measurement system was designed to provide a baseline to measure progress; identify weaknesses in installed systems; and monitor, on a continuing basis, the functioning of the systems. However, according to a DOE official, this measurement system was not adopted because it was too complex and time-intensive to implement.

DOE is currently collecting from individual sites information that would be useful in measuring the new systems' effectiveness. Project teams make visits to sites and observe systems that have been installed. At certain sites, DOE has contracts with the Russian sites to collect information on the functioning of equipment such as nuclear material portal monitors,

which can indicate how often the system has been operating and whether any problems have caused it to malfunction or be turned off. In addition, before installing security systems, DOE and Russian site officials conduct vulnerability assessments, which assess the probability of the existing nuclear security systems at the sites to prevent nuclear material theft. DOE officials also conduct joint visits to the sites with Gosatomnadzor (GAN)—the Federal Nuclear Radiation Safety Authority—and MINATOM officials to observe informal functional testing of such systems as alarms, and sensors and to discuss the operations of the systems with site personnel.

DOE Is Providing Long-Term Assistance to Operate and Maintain the Security Systems

DOE is providing sites in Russia with assistance to operate and maintain the new security systems after they are installed. DOE also has projects under way with MINATOM and GAN to develop nuclear material security regulations and enforcement, establish nuclear material security training centers, and install security improvements for trains and trucks that transport nuclear material between and within sites. While DOE has made progress on these projects, DOE does not expect to complete them before 2020. The Department initially planned to assist each site for up to 3 years after the installation of the security systems, but it currently anticipates that some sites will require assistance for longer periods because of poor economic conditions, while other sites may require less assistance.

DOE Is Assisting Sites With the Operation and Maintenance of the New Security Systems

DOE is assisting Russian sites with the long-term operations and maintenance of new security systems after the complete systems are installed. DOE refers to this as *operational assistance*; it includes the following:

- Warranties, maintenance, and spare parts that provide the sites with the ability to repair and replace system elements.
- Training of site personnel on how to operate and maintain equipment.
- Writing of procedures that instruct site personnel on how to control access to nuclear material, track nuclear material inventories and transfers made among buildings, and otherwise operate the installed systems.

According to DOE officials, operational assistance is necessary because the Russian sites where DOE helped install nuclear security systems lack the financial resources, adequately trained staff, and the knowledge of procedures to operate and maintain the systems effectively. For example, many of the sites cannot afford the warranties, parts, or technical support necessary to ensure that the new systems are fully operational. At six of

the nine sites we visited, Russian officials stated that without assistance, operating the systems would be difficult. Russian and DOE officials said that while sites would still attempt to operate the equipment if assistance were no longer available, the level of operation and maintenance would be reduced, leaving material more vulnerable to theft.

In addition to providing operational assistance for sites with completed security systems, DOE officials are modifying the design and installation of security systems at sites where work is ongoing to minimize the amount of operational assistance that these sites will require once their systems are complete. For example, project teams are designing systems that use equipment produced in Russia rather than foreign-made equipment because Russian equipment may be easier for the sites to service and replacement parts may be more readily available. In addition, when designing security systems, project teams are considering how the sites will be able to integrate the systems into the sites' activities, for example, by considering how many people enter and exit the sites each day when deciding where to place nuclear material portal monitors.

DOE Is Assisting Russian Agencies That Regulate and Enforce Nuclear Security

In addition to operational assistance to sites, DOE is assisting Russia with developing regulations and enforcement activities for nuclear material security, developing a national inventory of nuclear material, training personnel on nuclear material security, and improving the security of nuclear material while in transit. The two primary recipients of this assistance, which DOE refers to as *national infrastructure assistance*, are MINATOM and GAN. DOE is assisting both organizations with writing regulations and developing inspection systems for sites under their control. Currently, about half the necessary nuclear material security regulations have been developed, and DOE anticipates it will be several more years before all the necessary regulations are in place and adopted. Additionally, DOE is supporting GAN's inspection and enforcement role by training GAN inspectors on how to carry out their responsibilities, providing equipment that the inspectors use to take measurements of the nuclear material when they go to sites, and conducting joint site visits with DOE project teams to ensure that the inspectors understand their roles and responsibilities.

DOE is providing MINATOM with assistance to develop a national nuclear material inventory, which is required under Russia's new regulations. This requirement is an important element in strengthening nuclear material security in Russia. By requiring sites to make inventory information available to a national database on a periodic basis, the Russian

government can improve its ability to track the location, type, and quantity of material at its nuclear facilities and detect possible thefts. Currently, 20 percent of the sites with weapons-usable nuclear material in Russia are reporting inventory information to the national database, and DOE officials expect that it will be at least 3 more years before all sites are reporting some level of data.

In addition to regulatory and enforcement activities, DOE is also supporting the development of nuclear material training centers in Russia. For example, DOE is supporting two centers that train personnel on how to operate and maintain the systems. The Russian Methodological Training Center specializes in material control and accounting training, and the Interdepartmental Special Training Center specializes in physical protection training. DOE is also supporting a 2-year graduate program in nuclear material security at the Moscow Engineering Physics Institute for site managers and nuclear security officials.

DOE is also providing physical protection systems for the trucks and rail cars used in transporting nuclear material. The trucks and rail cars can handle large bulletproof containers equipped with security locks used to carry nuclear material while in transit. The containers are difficult to steal because they are heavy and require cranes for loading on and off the trucks and rail cars. DOE is also supporting other national efforts, such as the provision of materials to be used at sites to calibrate equipment.

Need for Operational Assistance Will Vary Among Sites in Russia

DOE plans to assist every site to ensure the long-term operation of nuclear security systems after their installation. DOE has limited information on how much assistance each site requires because it has not conducted a programwide assessment of the cost of operating and maintaining the systems and the sites' ability to cover these costs. Furthermore, DOE only recently began providing completed sites with operational assistance and has limited experience in gauging how much assistance these sites or others will need and for how long.

DOE officials initially estimated that sites would require operational assistance for up to 3 years after the new security systems' installation. However, on the basis of the experience at the sites where the installation of security systems is complete, DOE officials now anticipate that some sites will require assistance for longer periods of time. This shift to support the systems for a longer period than originally anticipated is due to several factors, including (1) the poor economic conditions at some sites, (2) the sites' need for technical assistance to operate some of the

installed equipment, and (3) the low priority that some sites attach to nuclear material security.

To determine the amount and type of assistance that is needed, DOE officials are surveying six of the completed civilian sites with regard to their need for spare parts, warranties, procedures, training, and operational funding. On the basis of the results of the survey and discussions with the sites, DOE will determine what type of assistance the sites need to ensure that the systems are properly operated. However, DOE officials have not surveyed other sites to determine what their current security system costs are and whether they have the financial and technical resources to maintain the newly improved systems. Some of these sites where DOE is still installing systems are larger and in better financial condition than the six sites in the study. Because larger sites may have more resources and greater potential to generate revenue, the level of assistance will differ from that required at smaller sites with more limited resources and income potential.

DOE Faces Challenges in Meeting Program Cost Estimates and Time Frames

DOE estimates that it will complete the Material Protection, Control, and Accounting program in 2020 at a total cost of about $2.2 billion. However, DOE officials said that the cost estimate and time frame are uncertain because DOE faces challenges in implementing the program. For example, DOE's initiative to consolidate the number of buildings and sites that contain nuclear material could reduce the cost of completing the program, but the initiative is encountering obstacles because MINATOM has not identified which buildings and sites it plans to close.

DOE Estimates That It Will Spend $2.2 Billion Through 2020 to Complete the Program

DOE estimated in 1995 that it would spend $400 million through fiscal year 2002 to finish installing the nuclear material security systems. Since 1995, the scope of the Material Protection, Control, and Accounting program has expanded. In response to our March 2000 recommendation to develop a new cost estimate and time frame for completing all the elements of the expanded program, the Department now estimates that it will complete the installation of security systems in 2011 and continue to provide assistance through 2020 at a total cost of $2.2 billion.

The 1995 estimate included the cost to install upgrades at buildings in Russia and other newly independent states of the former Soviet Union.[8] The current estimate includes the following:

- $823.1 million to complete the installation of nuclear material security systems in 288 buildings in Russia by fiscal year 2011.[9] This includes $74.9 million to complete Navy sites by fiscal year 2004, $212.7 million to complete civilian sites by fiscal 2008, and $535.5 million to complete the nuclear weapons laboratories by fiscal 2011.
- $711.8 million to support the long-term operation and maintenance of the systems through fiscal year 2020, including operational assistance to sites as well as assistance to the federal agencies that regulate and enforce nuclear material security.
- $387.2 million through fiscal year 2010 on an initiative to reduce the number of buildings and sites that contain nuclear material by consolidating Russia's nuclear material into fewer buildings and converting some of the material into a form that cannot be used for weapons.
- $241.3 million through fiscal year 2020 for program management, which includes the cost of the program's financial management system, compliance with export controls, contract management, travel coordination, administrative and secretarial support, and the Technical Survey Team.

The difference between the 1995 estimate and the current estimate is based on changes in DOE's assumptions about the scope of the nuclear material security problem in Russia, in particular, a threefold increase in the number of buildings in Russia where DOE is installing security systems. In addition, DOE officials' initial assumption that Russia would reach a level of economic stability by 2000 to support the long-term

[8]The other newly independent states where DOE installed nuclear security systems include Belarus, Georgia, Kazakstan, Latvia, Lithuania, Ukraine, and Uzbekistan. In 1999, DOE completed the installation of the systems in these countries and transferred funding for sustaining the systems to DOE's Office of International Safeguards. The $2.2 billion estimate covers the costs of the program in Russia only. In addition, the $2.2 billion does not include the $474.8 million estimated cost for security systems at 42 Russian Navy nuclear weapons storage sites, discussed in appendix I, or $228.9 million for International Emergency Cooperation—a program, funded together with nuclear material security assistance to Russia, that assists other countries in cases of nuclear accidents or smuggling incidents.

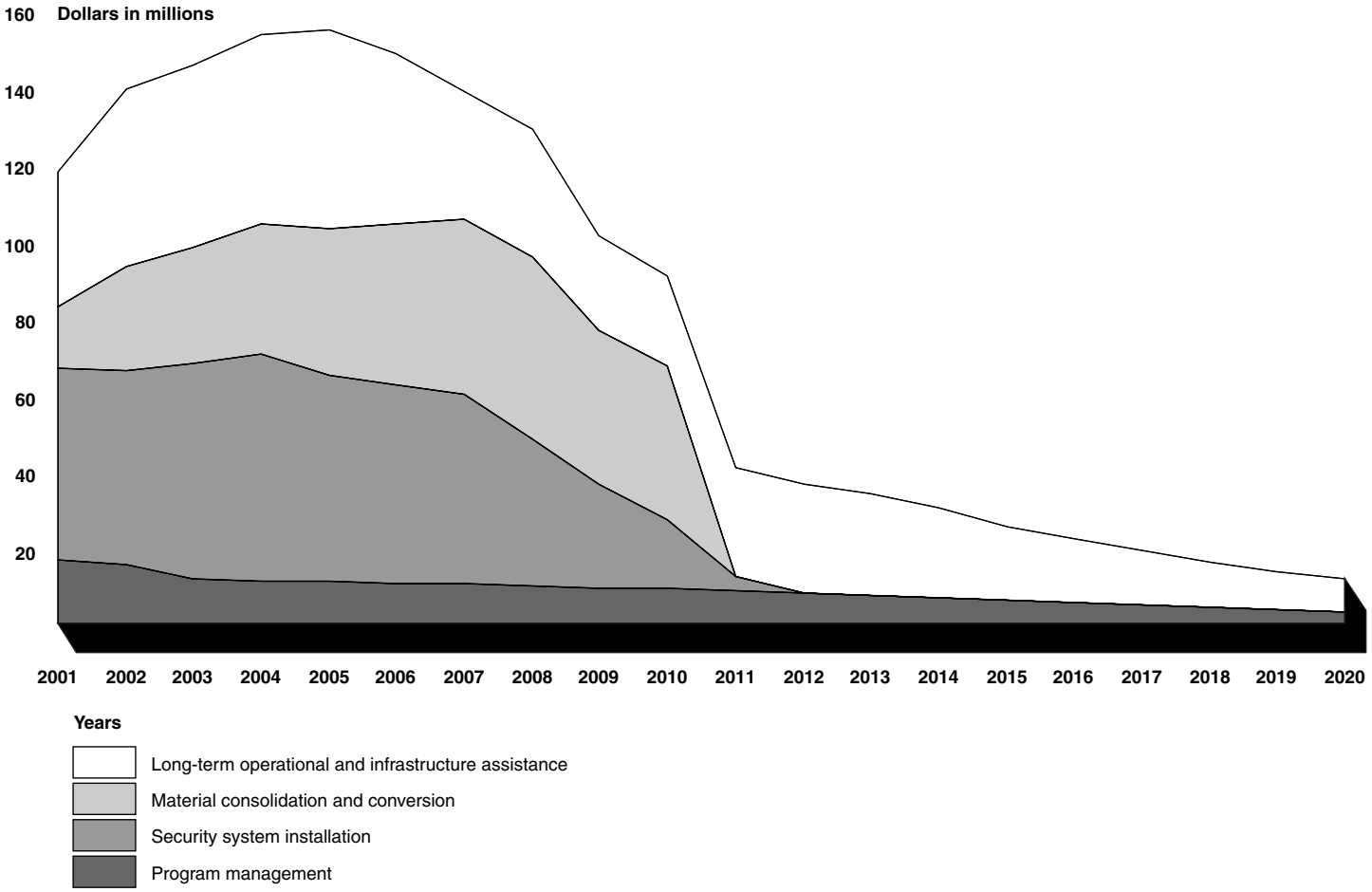
[9]Since DOE issued the cost and time frame estimate in July 2000, it has reduced the number of buildings needing security systems by 36.

operation and maintenance of the security systems did not materialize. DOE officials found that the economic decline culminating in the August 1998 collapse of the Russian economy adversely affected the ability of Russian sites to commit the necessary resources to fully sustain the security systems. Similarly, DOE officials found that Russia needs assistance beyond installing security systems, such as assistance with developing nuclear security regulations and enforcement capabilities. Consequently, DOE officials now assume that Russia will achieve the economic and political stability to operate and maintain the nuclear material security systems by 2015 and that DOE will gradually phase out assistance from 2015 through 2020. Finally, the limited access to sensitive buildings that MINATOM has given to DOE's project teams has caused delays in the plan to complete the installation of security systems by fiscal year 2002.

In developing the time frames for completing the program by 2020, DOE officials took into account several factors that limit how quickly it would be able to install security systems. In particular, DOE's time frame estimates take into account Russia's short construction season due to weather conditions, the sites' ability to provide the personnel to install the systems, and the time needed to negotiate access to sensitive sites. DOE officials also assumed that the portion of the Department's budget devoted to improving security at the 40 nuclear sites would increase from about $118 million in the fiscal year 2001 budget to $155 million in the fiscal 2005 budget.[10] According to a DOE official, if the program's funding were to remain at current levels, it will take at least 4 additional years to install security systems at Russian sites (from 2011 to 2015). Figure 4 shows DOE's yearly spending estimates for fiscal years 2001 through 2020.

[10] Information on DOE's expenditures through fiscal year 2000 can be found in appendix IV.

Figure 4: DOE's Cost Estimate to Complete the Material Protection, Control, and Accounting Program, Fiscal Years 2001-20



DOE's Cost Estimate and Time Frame Are Uncertain

DOE officials expressed uncertainty about the cost estimate and time frame for completing the program because of a number of issues, including the lack of access to sensitive sites and DOE's limited experience in some types of assistance that it is providing.

DOE officials said that the greatest uncertainty in the cost estimate and time frame for completing the installation of security systems stems from the lack of access to sensitive sites, in particular, the nuclear weapons laboratories. In contrast, DOE officials have the most confidence in the cost estimates for sites where its project teams have good access for designing and installing the systems, such as most civilian and Russian Navy sites. The lack of access creates uncertainty because project teams do not know how many buildings at the nuclear weapons laboratories

require security systems or when they will be able to start and complete the installation of security systems. The number of buildings is a major factor in the cost of improving security at a site because each building requires that the project team design and install a unique security system. Some of the nuclear weapons laboratories may have more buildings than DOE officials have assumed, and others may have fewer.

DOE officials are also uncertain of the cost estimate for installing security systems because project teams have less experience in installing and developing cost estimates for security systems at the large and complex buildings in the nuclear weapons laboratories that enrich uranium or reprocess plutonium for use in weapons. Although DOE has installed security systems for buildings where Russian civilian sites work with nuclear material, the buildings where the weapons laboratories work with nuclear material are much larger. Therefore, DOE cannot assume that the cost of installing security systems at buildings in the weapons laboratories is about the same as it is at civilian sites.

Another source of uncertainty in the program's cost estimate for completing the program stems from DOE's limited experience in providing operational assistance to sites and assistance to Russia's regulatory and enforcement agencies. On the basis of its limited experience in providing a handful of small completed civilian sites with operational assistance, DOE officials used generic assumptions about how much assistance it would provide at each site after installing nuclear security systems rather than developing individual estimates for each of the sites. At most sites, DOE officials anticipate that the Department will provide operational assistance, at gradually declining levels, through 2020. Similarly, DOE officials regard their assistance to Russia's nuclear regulatory and enforcement agencies as a long-term effort to continue through 2020, but DOE has not yet completely determined what the assistance will consist of beyond its plans for the next few years.

DOE plans to update its cost estimate and time frame for completing the program annually. DOE officials said that they would develop more confidence in their estimates as they gain more experience in the areas where there is currently more uncertainty. For example, DOE officials expect to complete the installation of security systems at two sensitive uranium-processing sites where project teams have physical access in fiscal year 2001. After completing these two sites, DOE will have a better basis to estimate the costs of installing systems at large processing buildings in the nuclear weapons laboratories. Similarly, DOE is just beginning to implement a pilot project to negotiate alternatives to physical

access at sensitive buildings at two nuclear weapons laboratories. The outcome of the pilot project will help DOE officials make better assumptions about the process of gaining access to buildings in the rest of the nuclear weapons laboratories.

DOE is in the process of developing for the program a strategic plan that ties together the program's goals, priorities, and strategies for reducing the risk of theft in Russia with the program's costs and time frames for completing the program. Such a plan could provide DOE managers with guidance as they adjust the implementation of the program to take into account changes in time frames for installing systems and the amount of access DOE project teams may have to buildings. According to a DOE official, the plan, when completed in April 2001, will tie together the cost estimate and time frame for completing the program with a revised version of the Guidelines for Material Protection, Control, and Accounting Upgrades at Russian Facilities which, among other things, sets out the program's goals, priorities, and strategies for installing security systems that reduce the risk of theft at Russian sites.

Material Consolidation and Conversion, if Successful, Could Reduce Program Costs and the Number of Buildings That Contain Nuclear Material

Under the Material Consolidation and Conversion initiative, one of DOE's strategies for completing the program is to reduce the number of buildings and sites that contain nuclear material and need security systems. DOE's cost estimate and time frame for completing the program sets a goal of closing 50 buildings and five sites by 2010. Under the initiative, the reduction would take place by consolidating nuclear material into fewer buildings and sites and converting 24 metric tons of highly enriched uranium, or about 3 percent of the estimated 603 metric tons of weapons-usable nuclear material in Russia, into low enriched uranium that cannot be used for weapons.[10] DOE estimates that the Material Consolidation and Conversion initiative will cost $387.2 million through fiscal year 2010.

If DOE is successful in implementing the initiative, the overall cost of the program could decrease because fewer buildings and sites would need nuclear material security systems. The potential cost savings of the initiative depends in large part on the complete removal of material from buildings or sites. In such cases, DOE would avoid the cost of installing

[11]According to DOE, about three-quarters of the material to be converted will be uranium enriched to 85 percent in the isotope U-235. DOE officials told us that by converting this material, risk will be reduced for material that is some of the most attractive to theft in Russia.

security systems or, if the systems are already installed, providing assistance for their operation and maintenance. In addition, the initiative would completely eliminate the risk of theft at the buildings and sites that no longer contain nuclear material. However, the initiative has had limited success since its inception in 1999. In particular, the Material Consolidation and Conversion initiative has not resulted in the complete removal of weapons-usable nuclear material from any buildings or sites.[10] Furthermore, DOE faces a number of obstacles to implementing the initiative, in particular, MINATOM's reluctance to identify which sites and buildings will close.

DOE is working with MINATOM to develop a plan for the Material Consolidation and Conversion initiative that identifies which buildings and sites will no longer contain nuclear material. In May 2000, MINATOM presented DOE with a draft of the plan that envisioned closing 60 buildings and converting about 27 metric tons of material, but the draft did not identify which buildings would close. According to DOE officials, MINATOM wants a separate arrangement on the initiative before it provides DOE with information on what buildings and sites will close, but the United States has temporarily suspended negotiations on such an arrangement because of U.S. policy concerns about Russia's nuclear cooperation with Iran. In the meantime, without information on which buildings and sites will close, DOE risks installing nuclear security systems at buildings or sites that will contain nuclear material for only a short period of time. If this happens, DOE would spend funds to install security systems at buildings that will not ultimately need them.

Another obstacle to the Material Consolidation and Conversion initiative is the reluctance of sites in Russia to give up their nuclear material. The sites are reluctant because they may have an ongoing need for the material and because personnel at the sites may lose special status and benefits that come with working with nuclear material such as extra vacation, early retirement, and higher pay. For example, DOE and MINATOM agreed in 1999 to the goal of removing all the nuclear material from two buildings at the Lytkarino Research Institute of Scientific Instruments by the end of 2000 by converting the site's highly enriched uranium to low enriched

[12]The program has had more success at removing materials from buildings at sites that are not in the initiative. DOE has helped Russian facilities consolidate materials into fewer buildings at the State Research Institute, Scientific Industrial Association; the Institute of Physics and Power Engineering; Dmitrovgrad; Novosibirsk; and several of the Russian Navy's nuclear fuel storage sites.

uranium. However, both of the buildings still contained nuclear material when we visited the site in October 2000, and site officials told us that they do not plan to provide material for conversion under the initiative for the next 2 to 3 years. We also met with officials at the State Research Institute, Scientific Industrial Association (also known as Luch)—one of the two sites that is converting highly enriched uranium to low enriched uranium. These officials told us that they are encountering difficulties in obtaining highly enriched uranium for conversion because Russian sites believe they will receive more money and support from DOE by retaining their weapons-usable nuclear material.

As of December 2000, the initiative resulted in the conversion of about 1.6 metric tons of highly enriched uranium. DOE officials have also successfully negotiated verification measures with both of the sites that are converting the material to provide assurances that the sites actually convert highly enriched uranium to low enriched uranium that cannot be used for weapons. However, DOE's initiative has not yet resulted in the closure of any buildings or sites; therefore, DOE officials are not sure of the extent to which the initiative will result in an overall cost savings to the program. Furthermore, while material conversion is reducing the proliferation risk for the material converted to low enriched uranium, it is not reducing the risk of theft at the buildings and sites that are contributing the highly enriched uranium because those buildings and sites still contain weapons-usable nuclear material and still require nuclear security systems. Given the lack of progress in closing buildings and sites, DOE officials said that they are reevaluating whether to continue with material conversion. DOE officials said that the initiative's primary goal is to reduce the risk of nuclear material theft and that they favor continuing the material conversion even if it does not result in the closure of any buildings or sites because the risk of theft for the material that is converted would still be eliminated.

Conclusion

DOE is improving the security of 192 metric tons of weapons-usable nuclear material in Russia by installing modern security systems that detect, delay, and respond to attempts to steal nuclear material. These systems, while not as stringent as those installed in the United States, are designed to reduce the risk of nuclear material theft at Russian sites. While Russia and the United States have worked cooperatively to reduce the risk of theft in Russia, Russian officials' concerns about divulging national security information continue to impede DOE's efforts to install systems for several hundred metric tons of nuclear material at sensitive Russian sites. Continued progress in reducing the risk of nuclear material theft in

Russia hinges on DOE's ability to gain access to Russia's sensitive sites and reach agreement with MINATOM to reduce the number of sites and buildings where nuclear material is located. Achieving these two goals would improve security for large amounts of nuclear material and reduce program costs. Regarding the systems that are already installed, DOE currently does not have a means to periodically monitor the systems to ensure that they are operating properly on a continuing basis. Such a mechanism would provide DOE officials with increased confidence that the security systems are reducing the risk of nuclear material theft.

The fact that DOE is developing a strategic plan that ties together the program's goals, priorities, and strategies for reducing the risk of theft in Russia with the cost and time frames estimate is a positive step forward. Such a plan will provide DOE managers with guidance as they adjust the implementation of the program to take into account the changes in the time frames for installing systems and the amount of access that DOE project teams may have to buildings. We believe that the plan developed by DOE should provide an estimate of how much sustainability assistance is required on the basis of an analysis of the costs to operate and maintain the systems and the sites' ability to cover these costs. In addition, the plan should provide options for completing the program on the basis of the progress made on gaining access to sensitive sites and the closure of buildings and sites.

Recommendations for Executive Action

In order to assist DOE in its mission of promoting nuclear nonproliferation and reducing the danger from weapons of mass destruction, we recommend that the Administrator of the National Nuclear Security Administration

- develop a system, in cooperation with the Russian government, to monitor, on a long-term basis, the security systems installed at the Russian sites to ensure that they continue to detect, delay, and respond to attempts to steal nuclear material and
- include in the strategic plan being developed by DOE (1) an estimate of how much sustainability assistance is required on the basis of an analysis of the costs to operate and maintain the systems and the sites' ability to cover these costs and (2) options for completing the program on the basis of the progress made in gaining access to sensitive sites and on the closure of buildings and sites.

Agency Comments and Our Evaluation

In commenting on a draft of our report, DOE generally agreed with our findings and concurred with our recommendations.

In its comments, DOE stated that in addition to the amount of nuclear material that received the completed and partially completed security systems cited in the report, the program has work under way on an additional 130 metric tons of nuclear material. We incorporated this fact into the report where appropriate. DOE also stated that it has work under way to improve security at 42 nuclear weapon sites that contain about 260 metric tons of material. As discussed in our report, the scope of our work includes DOE's assistance to improve the security of weapons-usable material controlled by Russia's civilian authorities, nuclear weapons laboratories, and the naval nuclear fuel storage facilities. Appendix I discusses the status of DOE's nuclear weapons security work, and we have added the fact that the 42 sites contain about 260 metric tons of nuclear material into appendix I where appropriate.

DOE also noted in its comments that it has recently reached a draft agreement with MINATOM to provide DOE personnel with greater access to sensitive MINATOM sites. This agreement is undergoing interagency review with the executive branch. According to the Department, while some of the more sensitive areas at MINATOM's nuclear sites may remain inaccessible to program personnel, this agreement will allow the program to expand its work once it is concluded. We incorporated this information into the report where appropriate.

Scope and Methodology

The scope of our review includes DOE's assistance to improve the security of weapons-usable nuclear material controlled by Russia's civilian authorities, nuclear weapons laboratories, and Navy nuclear fuel storage facilities. We reviewed DOE's program to (1) install nuclear security systems at sites; (2) assist sites with the long-term operation of the installed systems; (3) support the development of regulations and the enforcement of nuclear material security, nuclear material security training centers, and security improvements to trains and trucks used to transport nuclear material between and within sites; and (4) reduce the number of buildings and sites that contain nuclear material through consolidation and conversion.

To meet our objectives, we analyzed DOE's program documents, including the Technical Survey Team's assessments of the status of nuclear security efforts at sites and their compliance with DOE's guidance. At the nine sites we visited in Russia, we observed nuclear security systems and spoke with Russian officials responsible for working with DOE project teams to install

and operate the systems. We also met with MINATOM and GAN officials to discuss the overall status of cooperation to improve nuclear material security in Russia. In addition, we met with DOE project teams to discuss their efforts to improve nuclear material security. We analyzed information from DOE on the number of buildings where the installation of nuclear material security systems is complete, the number where systems are currently being installed, and the number of buildings where work has yet to be initiated. We met with DOE officials in charge of managing the program to discuss DOE's policy on access to sensitive Russian sites and how DOE measures the effectiveness of the nuclear security systems.

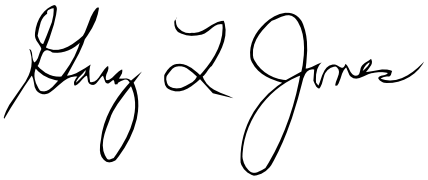
We analyzed DOE's assistance to sites to support the operation of the nuclear material security systems and assistance to the federal agencies that regulate and enforce nuclear security by reviewing program documents, meeting with DOE officials, and discussing the need for long-term support with Russian officials. We analyzed DOE's cost estimate and time frame for completing the program, including the estimate for completing the installation of nuclear security systems and helping sites operate the systems after their installation. We met with DOE officials to discuss the methodology for developing the cost estimate and time frame and their assumptions about key factors influencing the estimate. We reviewed the status of the Material Consolidation and Conversion initiative by analyzing DOE documents; meeting with DOE officials responsible for the initiative; and discussing the initiative with MINATOM, GAN, and Russian site officials. We obtained the program's budget, obligation, and expenditure data through fiscal year 2000 from DOE. We did not independently verify the quality or accuracy of the financial data that program managers and laboratory personnel provided us with, but we compared the data with DOE's Program Management Information System and found that it matched the data that DOE provided us with.

We interviewed officials from DOE's Office of International Materials Protection and Emergency Cooperation and from the national laboratories, including Brookhaven, Lawrence Livermore, Los Alamos, Oak Ridge, Pacific Northwest, and Sandia. We conducted our review from April 2000 through February 2001 in accordance with generally accepted government auditing standards.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies of this report to the Honorable Spencer Abraham, Secretary of Energy; the Honorable Colin L. Powell, Secretary of State; the Honorable Donald H. Rumsfeld, Secretary

of Defense; the Honorable Mitchell E. Daniels, Director, Office of Management and Budget; and interested congressional committees. We will make copies available to others on request.

If you have any questions concerning this report, we can be reached at (202) 512-3841 and (202) 512-4128, respectively. Major contributors to this report include Gene Aloise, F. James Shafer, Charles Bolton, Joseph Cook, and Julie Hirshen.



(Ms.) Gary Jones
Director, Natural Resources
and Environment

Harold J. Johnson
Director, International Affairs
and Trade

Appendix I: DOE's Program to Install Security Systems at Russian Navy Nuclear Weapons Sites

In 1999, at the request of the Russian Navy, the Department of Energy (DOE) began installing security systems to protect the Russian Navy's nuclear weapons. This work is being done under the Department's Material Protection, Control, and Accounting program. U.S. officials are concerned about the security of nuclear weapons in Russia. Although there have been no known incidences, concerns exist that a Russian nuclear warhead could be lost or stolen. Under the program, DOE is installing security components, such as fences, strengthened vault doors, sensors for the fences and doors, access control systems, strengthened guard towers, video surveillance equipment, and radio communication equipment for the response forces for 42 Russian naval sites where nuclear weapons are stored. According to DOE, the 42 sites contain about 260 metric tons of nuclear material. DOE officials estimate that this work will cost about $474.8 million—$336.8 million for the installation of security systems at the 42 sites by the end of fiscal year 2004, and $138.0 million for long-term operational assistance for the 42 sites through fiscal 2020.

As of January 2001, DOE has begun installing the systems at 41 of the 42 sites. DOE installs the systems in two phases. During the first phase, DOE (1) installs security components that are intended to quickly improve the sites' ability to protect their weapons, such as fences, vehicle barriers, strengthened doors, and mechanical locks, (2) bricks up windows at storage buildings, and (3) strengthens the guard towers on site. In phase two, DOE installs additional components, such as communication systems, interior and exterior detection and assessment systems, and access-delay systems which provide greater protection for the weapons. As of January 2001, DOE had completed the first phase of security improvements at 19 sites and the second phase improvements at 1 site.

The Russian Navy has provided the project teams with limited access to the sites. According to a DOE official, project team members have been granted physical access to seven sites. For the other sites where DOE has done work, the Russian Navy has allowed team members to view the sites from a distance, for example, allowing them to drive by it, park at the site to view it, or walk up to the site's perimeter. DOE obtains confirmation that the equipment has been installed and is being used as intended through photographs of the site after the work is complete, during site visits by project team personnel, and through written certification by the Russian Navy.

The cost of the first phase of security improvements is approximately $475,000 for each site, while the cost for the more comprehensive

improvements is estimated to be about $8 million per site. In its cost estimate for the Russian Navy's nuclear weapons sites, DOE officials also anticipate that each site will require about $300,000 per year in long-term operational assistance after the systems are installed, with the amount required diminishing over time. DOE, however, does not know how many years of long-term operational assistance will be required. While DOE estimates that it will complete the installation of security systems at the 42 known sites by the end of 2004, the Russian Navy has indicated that it would also like improved security systems installed at other locations, which could expand the program further. As of January 2001, however, the Navy had not specifically identified additional sites.

Appendix II: Status of Installed Security Systems in Russia

Table 3: Installed Nuclear Security Systems in Russia, Sitewide

Site	Number of buildings	Date completed
Joint Institute of Nuclear Research, Dubna	2	Feb. 1998
Moscow Scientific Research and Design Institute of Power Technology	2	Feb. 1998
Moscow Institute of Theoretical and Experimental Physics	3	Feb. 1998
Karpov Institute of Physical Chemistry	3	Feb. 1998
Beloyarsk Nuclear Power Plant	3	May 1998
Sverdlovsk Branch of Scientific and Design Institute of Power Technology	5	May 1998
Khlopin Radium Institute	4	May 1998
Petersburg Nuclear Physics Institute	4	May 1998
Moscow Engineering Physics Institute	4	June 1998
Tomsk Polytechnical University	3	July 1998
Krylov Shipbuilding Institute	3	Nov. 1998
Navy Site 49	4	Sept. 1999
Navy Site 34	2	Sept. 2000
Navy Refueling Ship PM-12	2	Sept. 2000
Navy Refueling Ship PM-63	2	Sept. 1999
Navy Refueling Ship PM-74	2	Aug. 2000
Ice Breaker Fleet, Imandra	2	Sept. 1999

Source: DOE.

Table 4: Installed Systems at Individual Buildings at Sites

Site	Program sector	Total number of buildings on site	Number of buildings with completed or partially completed systems installed
Institute of Physics and Power Engineering, Obninsk	Civilian research	12	8
Lytkarino	Civilian research	3	2
Novosibirsk	Civilian research	3	2
Elektrostal	Civilian research	11	2
Bochvar	Civilian research	8	0
Dmitrovgrad	Civilian research	10	5
Luch	Civilian research	6	4
Kurchatov Institute	Naval fuel	13	6
Sergiev Posad	Naval fuel	3	1
Site 32	Naval fuel	2	2
Site 86	Naval fuel	2	1
Sarov (Arzamas-16)	Nuclear weapons	40	5
Snezhinsk (Chelyabinsk-70)	Nuclear weapons	21	7
Ozersk (Mayak)	Nuclear weapons	18	1
Seversk (Tomsk-7)	Nuclear weapons	20	9
Zhelenznogorsk (Krasnoyarsk-26)	Nuclear weapons	6	3
Zelenogorsk (Krasnoyarsk-45)	Nuclear weapons	5	2
Novouralsk (Sverdlovsk-44)	Nuclear weapons	5	5
Avangard	Nuclear weapons	3	0
Zarechnyy (Penza-19)	Nuclear weapons	3	0
Trekhgorny (Zlatoust-36)	Nuclear weapons	3	0
Lesnoy (Sverdlovsk-45)	Nuclear weapons	3	0

Source: DOE.

Appendix III: Profile of Nuclear Sites in Russia Visited by GAO

Northern Fleet Storage Facility (Site 49)

Northern Fleet Storage Facility (Site 49) is located within the Russian Federation Naval Base at Severomorsk, about 9 miles northeast of Murmansk on the Kola Peninsula. Site 49 is the primary land-based storage facility for reactor fuel assemblies used by the Russian Northern Fleet naval vessels and holds tens of metric tons of weapons-usable nuclear materials. DOE helped install nuclear security systems and provided assistance to expand the storage bunker for the reactor fuel assemblies, which allowed the Northern Fleet to consolidate all of its fresh nuclear fuel at the site. DOE began work to improve the nuclear security at Site 49 in May 1996 and completed the installation of security systems in September 1999.

Krylov Shipbuilding Research Institute

The Krylov Shipbuilding Institute is located in St. Petersburg and employs over 3,000 scientists and support staff. The Institute's nuclear facility has a research reactor and three critical assemblies containing hundreds of kilograms of weapons-usable nuclear material. DOE began installing physical protection and material control and accounting systems at the site in April 1997 and completed the work in November 1998.

The Kurchatov Institute

The Kurchatov Institute is located in Moscow, about 10 miles from the Kremlin. Founded in 1943 as the Soviet Union's first nuclear weapons research site, the Institute is an independent laboratory under the direct authority of the Russian government. The Institute's research activities include the design and development of nuclear reactors for the Russian Navy, for the Russian icebreaker fleet, and for space applications. The Institute operates 6 research reactors and 14 critical assemblies, and has three storage facilities containing several metric tons of nuclear material. DOE began installing security systems at the Institute in August 1994.

Petersburg Nuclear Physics Institute

The Petersburg Nuclear Physics Institute is located in the town of Gatchina, about 30 miles south of St. Petersburg. The Institute is operated by the Russian Academy of Sciences and has one operating nuclear research reactor, one reactor under construction, one critical assembly, and a vault to store reactor fuel with hundreds of kilograms of nuclear material. DOE installed the new security systems at the site from February 1996 to May 1998.

Institute of Physics and Power Engineering

The Institute of Physics and Power Engineering is operated by Russia's Ministry of Atomic Energy and is located in the city of Obninsk, about 66 miles southwest of Moscow. The Institute is involved in the research and development of nuclear power reactors and employs about 5,000 people. The Institute possesses several metric tons of weapons-usable nuclear material. DOE began installing security systems at the Institute in September 1994 and is installing nuclear security systems in 11 buildings as well as in the central alarm station. DOE's project team also worked with the site to reduce the number of buildings that contain weapons-usable nuclear material from 22 to 7.

A.A. Bochvar All-Russian Scientific Research Institute of Inorganic Materials

The A.A. Bochvar All-Russian Scientific Research Institute of Inorganic Materials is located in northwest Moscow and is adjacent to the Kurchatov Institute. The Bochvar Institute was established in 1945 and conducted research for the Soviet Union's nuclear weapons program. The Institute, operated by Russia's Ministry of Atomic Energy, currently conducts research on nuclear fuel, including mixed-oxide fuel in support of Russia's plutonium disposition program, and employs about 1,300 people. Bochvar has several hundred kilograms of weapons-usable nuclear material on site. DOE began work at Bochvar in December 1997 but was limited by the site to installing material control and accounting systems until 1999, when the site agreed that DOE could begin installing physical protection systems.

State Research Institute, Scientific Industrial Association

The State Research Institute, Scientific Industrial Association (also known as Luch) is located about 22 miles south of Moscow. Luch is operated by Russia's Ministry of Atomic Energy and is involved in developing space and mobile reactors, including the TOPAZ reactor used in Russian satellites. DOE started work at Luch in late 1995 and is installing nuclear security systems in five buildings containing nuclear material and in a central alarm station. Luch, which has several metric tons of weapons-usable nuclear material on site, has consolidated the number of buildings where the material is located from 28 to 4. DOE is also contracting with Luch to convert highly enriched uranium to low enriched uranium under the Material Protection Control and Accounting program's Material Consolidation and Conversion initiative.

Lytkarino Research Institute of Scientific Instruments

The Lytkarino Research Institute of Scientific Instruments is located about 31 miles southeast of Moscow and is operated by the Ministry of Atomic Energy. The Institute is the primary organization in Russia for radiation resistance testing of materials, electronics, and electronic systems. DOE has worked with the Institute since September 1997 to install nuclear security systems in three buildings, including two containing nuclear materials and one central alarm station. The Institute contains hundreds of kilograms of weapons-usable material and participates in the program's Material Consolidation and Conversion initiative.

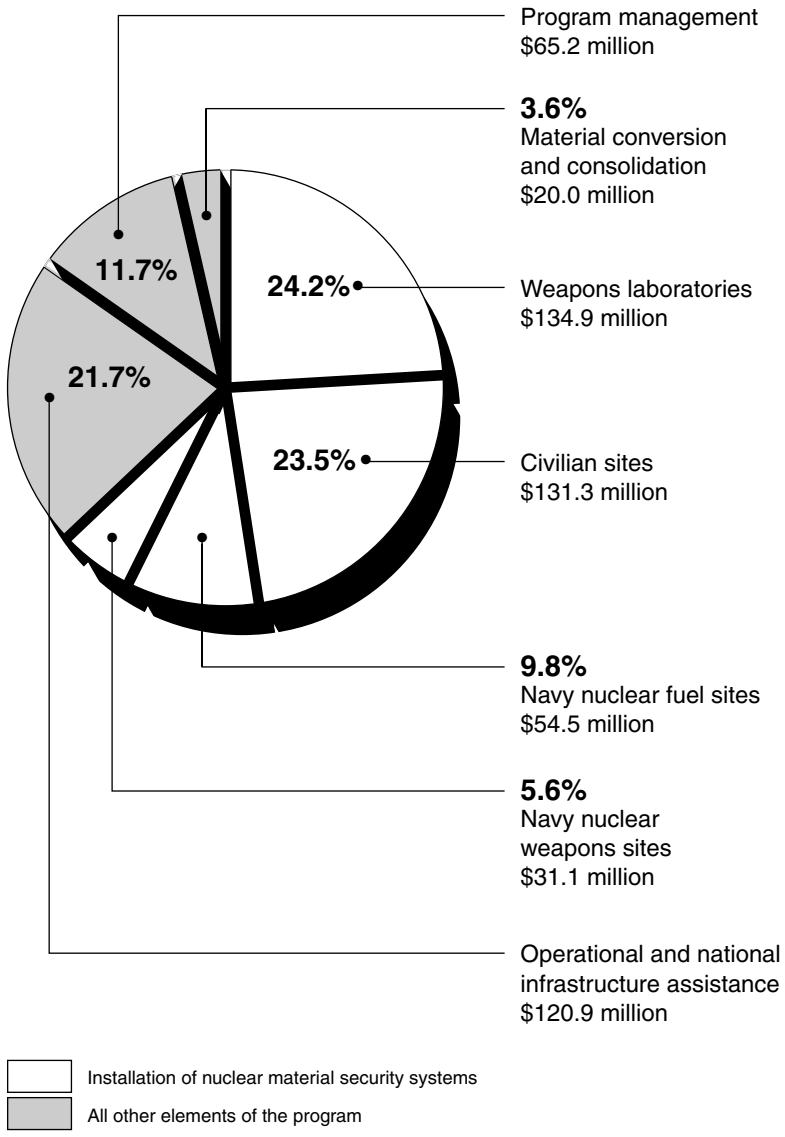
Moscow Engineering Physics Institute

The Moscow Engineering Physics Institute is a large university located in southeast Moscow. The Institute specializes in nuclear physics research and training and operates a research reactor using highly enriched uranium. The Institute has a small quantity of weapons-usable nuclear material on site. DOE worked with the Institute to install physical protection and material control and accounting systems in three buildings containing nuclear material and a central alarm station. DOE also supported the development of a graduate degree program in nuclear material security at the Institute. DOE began installing security systems at the site in February 1996 and completed the work in June 1998.

Appendix IV: DOE's Expenditures on Nuclear Material Security in Russia Through Fiscal Year 2000

From fiscal year 1993 through fiscal 2000, DOE spent $557.9 million on the Material Protection, Control, and Accounting program in Russia. As figure 5 shows, DOE spent $351.8 million, or 63 percent of the $557.9 million, on installing nuclear security systems at Russia's civilian sites, nuclear weapons laboratories, Navy nuclear fuel sites, and Navy nuclear weapons sites. DOE spent the remainder of the $557.9 million on operational and national infrastructure assistance, the Material Consolidation and Conversion initiative, and program management.

Figure 5: Breakdown of the $557.9 Million Spent on Nuclear Material Security, by Program Sector, Through Fiscal Year 2000



Note: The total does not equal 100 percent because of rounding.

Source: DOE.

For fiscal year 2000, DOE received an appropriation of $150 million for the program. The amount available for nuclear security assistance to Russia was reduced to $140.5 million by

- a general reduction of about $4.8 million to reduce the amount that DOE national laboratory personnel spend on travel and the number of national laboratory personnel on temporary assignment to the Washington, D.C., metropolitan area;
- a rescission of about $0.6 million as part of an omnibus appropriations act;
- a reprogramming of about $3 million to allow DOE to hire more federal managers for the program; and
- DOE's allocation of $1.2 million for International Emergency Cooperation, a related program that is included in the 20-year plan for completing the Material Protection, Control, and Accounting program but that is a separate program for assisting other countries in cases of nuclear accidents, nuclear smuggling, or terrorist incidents.

DOE also had a carryover of $85.5 million from fiscal year 1999, which brought the program's total fiscal year 2000 budget to $226 million. As of September 30, 2000, DOE had spent $138.7 million of its fiscal year 2000 budget, and it carried over $87.3 million into the program's fiscal 2001 budget. DOE's national laboratories obligated $59.4 million of the $87.3 million as of the end of fiscal year 2000. DOE had plans for the national laboratories to use the remaining $27.9 million to implement specific nuclear security projects, but the laboratories had not yet obligated these funds as of the end of the fiscal year.

Appendix V: Comments From the Department of Energy

Department of Energy
National Nuclear Security Administration
Washington, DC 20585

FEB 23 2001

Ms. Gary L. Jones
Director
Natural Resources and Environment
General Accounting Office
Washington, DC 20548

Dear Ms. Jones:

The National Nuclear Security Administration, and specifically, the Office of Defense Nuclear Nonproliferation has reviewed the General Accounting Office draft report, GAO-01-312, entitled "NUCLEAR NONPROLIFERATION: Security of Russia's Nuclear Material Improving; Further Enhancements Needed." This office and the Office of the Assistant Deputy Administrator for International Materials Protection and Emergency Cooperation appreciates the opportunity to have reviewed the draft report. Our comments are attached.

Sincerely,

Kenneth E. Baker
Acting Deputy Administrator for
Defense Nuclear Nonproliferation

Attachment

cc: DOE Audit Liaison
NNSA Executive Staff Director

Printed with soy ink on recycled paper

Comments on
GAO Draft Report
"NUCLEAR NONPROLIFERATION:
Security of Russia's Nuclear Material Improving;
Further Enhancements Needed
(GAO-01-312)"

General Comments

DOE appreciates the opportunity to review the draft General Accounting Office (GAO) report, "Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed." As the GAO notes, a substantial amount—192 metric tons—of proliferation attractive material has received security upgrades through the Material Protection Control and Accounting Program (MPC&A). We agree with your judgement that this figure is direct threat reduction activity that serves US national security objectives. We also agree with GAO that critical work remains and DOE has work underway on an additional 130 metric tons of material. We would appreciate your reference to this fact. In addition, DOE has work well underway at—and considerable resources spent on--42 nuclear weapons sites housing about 260 metric tons of nuclear material. When the work representing these figures (130 plus 260 metric tons) is complete, the Program will have secured about 67% of the material in Russia believed to require security upgrades. Again, we think it appropriate to reference this information.

Allow me to share with you my thoughts on two additional topics raised in the report. As noted by the GAO, one of the largest obstacles to program implementation has been securing appropriate access to sensitive MinAtom facilities. I am pleased to report that last week the MPC&A program reached a draft agreement with MinAtom that represents a breakthrough on this contentious issue. Upon completion of interagency review, the program will sign an access agreement providing MPC&A personnel with greater access to more sensitive MinAtom facilities than any U.S. nonproliferation program. Some of the most sensitive parts of these facilities in the future may remain for security reasons largely inaccessible to program personnel, but resolution of the access problem will create major opportunities for further expansion of the program's work. Because the access issue has been of such high interest to senior officials throughout the executive and legislative branches, you may want to add in your final report a sentence containing the fact of the recent progress made on access.

I also wanted to comment briefly on the references throughout the report on the work of our Technical Survey Team. As noted in the report, the survey team provides the program's senior management with comprehensive, independent and technical analyses of all of the MPC&A projects. I am under the impression that the GAO examiners apparently found the survey team's work invaluable, as I believe it to be. To my knowledge few, if any, U.S. Government nonproliferation programs maintain and support teams like our Technical Survey Team. They are an important program management tool.

An audit of a program as complex as MPC&A is a time consuming process that at times can become controversial and even contentious. Such was not the case during this study. The GAO personnel who reviewed the MPC&A program were highly professional, dedicated and thoroughly competent. They solicited and listened to our input on the program but came to their own conclusions. Their approach to this work is of value to program management

Recommendations

We recommend that the Secretary of Energy

Recommendation 1.

Develop a system, in cooperation with the Russians, to monitor on a long term basis the security systems installed at the Russian sites to ensure that they continue to detect, delay, and respond to attempts to steal nuclear material.

Management Position

Concur

As discussed in the report, the U.S. and the Russians have begun joint visits to monitor the success of the systems installed and the maintainability of the systems. Additionally, the program is developing a programmatic architecture that will integrate all of the monitoring efforts.

Recommendation 2.

Include in the strategic plan under development by DOE (1) an estimate of how much sustainability assistance is required based on an analysis of the costs to operate and maintain the systems and sites' ability to cover these costs; and (2) options for completing the program based on progress made on gaining access to sensitive sites and the closure of buildings and sites.

Management Position

Concur

The program strategic plan has been in development since December 2000. We anticipate publication of the strategic plan during the month of April 2001. As GAO recommends, we have been the process of incorporating requirements for sustainability, costs estimates of operations and maintenance of systems, and the exit strategy. Additionally, as stated in the general comments, upon completion of interagency review, the program will sign an access agreement providing MPC&A personnel with greater

access to sensitive MinAtom facilities. Some of the most sensitive parts of these facilities in the future may remain, for security reasons, largely inaccessible to program personnel, but resolution of the access problem will create major opportunities for further expansion of the program's work.

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