United States General Accounting Office

GAO

Report to the Chairman, Committee on Foreign Relations, U.S. Senate

October 1996

NUCLEAR SAFETY

Status of U.S. Assistance to Improve the Safety of Soviet-Designed Reactors

G A O
75 years
1921 - 1996

GAO/RCED-97-5

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-272926

October 29, 1996

The Honorable Jesse A. Helms
Chairman, Committee on Foreign
Relations
United States Senate

Dear Mr. Chairman:

The Moscow Nuclear Safety and Security Summit, held in April 1996, coincided with the tenth anniversary of the accident at the Chornobyl nuclear power reactor in Ukraine. This summit underscored the continuing concern that the United States and other countries have about the safety of 60 Soviet-designed civil nuclear power reactors operating in the Newly Independent States[1] and in the countries of central and eastern Europe. Fifteen of these reactors, known as RBMK reactors, are the type that exploded at the Chornobyl nuclear power plant. In 1994, we reported on international assistance efforts, including those of the United States, to improve the safety of the Soviet-designed reactors.[2] This report responds to your February 16, 1996, request to update our information on the U.S. nuclear safety assistance program.

In response to your request, this report provides information on (1) any changes in the goals of the U.S. safety assistance program since its inception, (2) the costs associated with the U.S. safety assistance program, and (3) the status of 13 (of 196) safety projects implemented by the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) and the way in which the agencies assess the effect of the projects on improving safety.

Results in Brief

The goals of the U.S. nuclear safety assistance program remain unchanged: to reduce the risk of accidents and to encourage the shutdown of the highest-risk Soviet-designed nuclear power reactors. Despite the efforts of the United States and other countries, none of the highest-risk reactors have been closed and one in Armenia has recently been restarted. DOE plans to increase its assistance to the RBMK reactors, which are considered the highest-risk, to improve their safety while they continue to

[1]The Newly Independent States are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgystan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Lithuania, which operates two Soviet-designed nuclear power reactors, is not considered one of the Newly Independent States.

[2]Nuclear Safety: International Assistance Efforts to Make Soviet-Designed Reactors Safer (GAO/RCED-94-234, Sept. 29, 1994).

operate. This action is being taken, in part, because the United States recognizes that these reactors may not be shut down for various reasons, including (1) the slow pace of economic reform in the countries operating the reactors, (2) concerns about the social and economic well-being of workers who would be displaced if the reactors were closed, and (3) the need to obtain financing to help develop replacement energy sources. In our view, providing this assistance could pose a dilemma because it may encourage the continued operation of the same reactors that the United States wants to see closed as soon as possible.

DOE, which is the main provider of U.S. nuclear safety assistance, originally planned its program to be short- to mid-term. However, the program has grown significantly because of the complexities and challenges involved in improving the safety of Soviet-designed reactors. DOE believes that the program should continue at least 10 more years and require about $500 million. DOE officials told us that they are developing a long-term plan that addresses how additional funds would be spent and how the program's long-term objectives would be met.

As of March 31, 1996, DOE and NRC (the other provider of U.S. assistance) had received $208 million for their nuclear safety assistance programs. These agencies had spent about $89 million, and DOE's expenditures constituted 88 percent of this amount. Of the total expenditures, about $42 million was for nuclear safety equipment and products. Other expenditures include program-related labor, travel, and overhead.

Eleven of the 13 DOE and NRC safety projects that we reviewed have experienced delays. For six of these delayed projects, U.S. equipment was not delivered to the plants in a timely manner because customs officials in Russia and Ukraine would not release the equipment. Other impediments, including a requirement that certain U.S.-supplied safety equipment be tested in Russia, have also contributed to delays. Despite these problems, several projects are progressing and have, for example, resulted in the installation of fire safety equipment and other safety-related hardware at plants in Russia and Ukraine and in the development of safety-related training programs in Ukraine. However, it is too early to assess the extent to which these projects are improving safety because only one—a study of nuclear energy options for Russia—has been completed. Although DOE and national laboratory officials are attempting to measure safety improvements, they recognize that it is difficult to quantify the impact of the assistance provided.

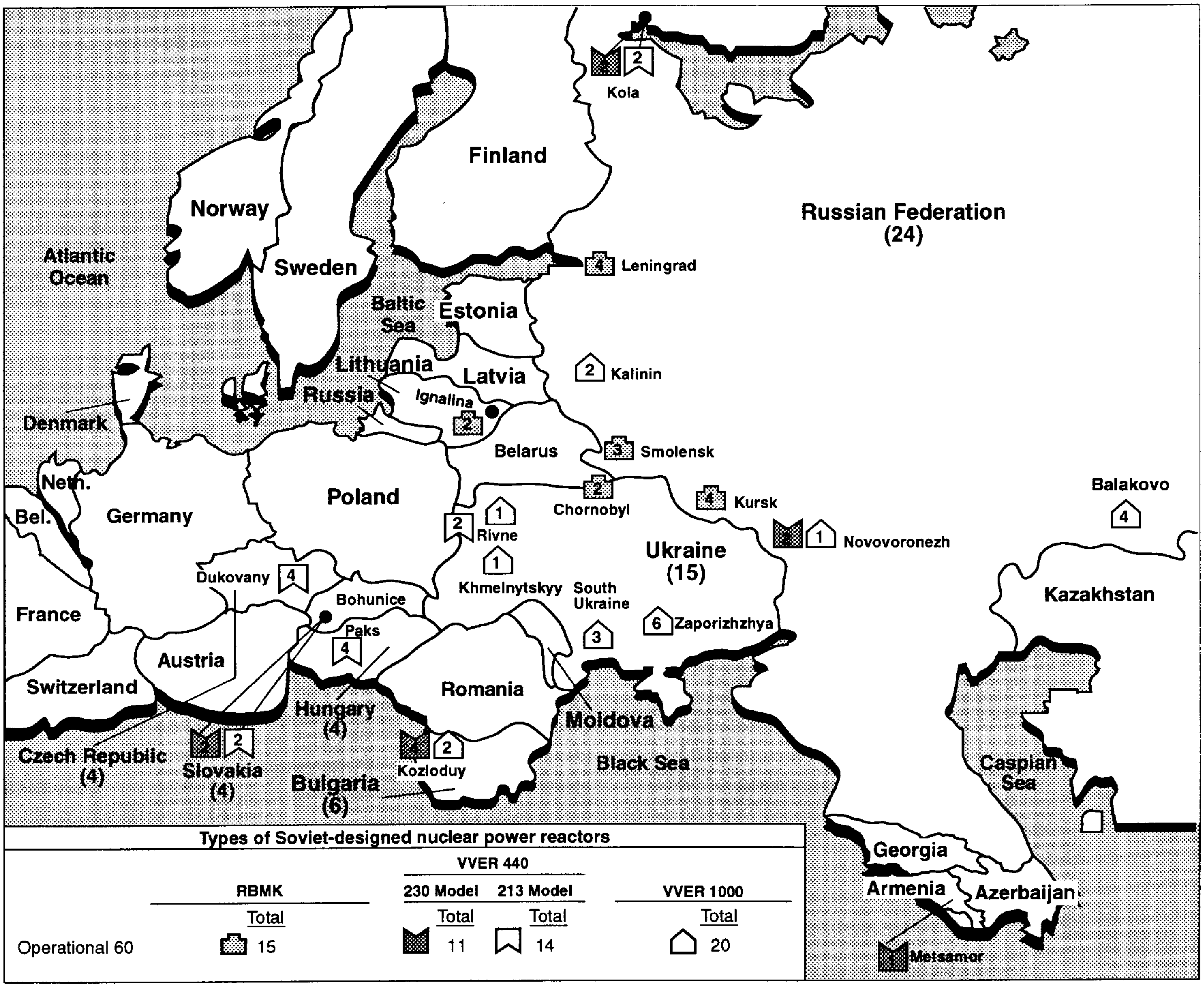
Background

In 1992, the U.S. government initiated a program known as the Lisbon Initiative on Multilateral Nuclear Safety. This program is designed to help improve the safety of Soviet-designed reactors. The U.S. program is part of a larger international effort to improve the safety of these reactors. As of February 1996, 22 donors, including the United States, had pledged or contributed more than $1.4 billion in assistance to this effort.

The 60 operational Soviet-designed nuclear power reactors pose significant risks because of deficiencies in their design and operation. Of greatest concern are 26 of these reactors that western safety experts generally agree fall well below accepted international safety standards and cannot be economically upgraded. These include 15 reactors known as RBMKs and 11 reactors known as VVER 440 Model 230s. The RBMK reactors—considered the least safe by western safety experts—and VVER 440 Model 230 reactors are believed to present the greatest safety risk because of inherent design deficiencies, including the lack of a containment structure,[3] inadequate fire protection systems, unreliable instrumentation and control systems, and deficient systems for cooling the reactor core in an emergency. Most of these reactors are located in countries that do not have independent or effective nuclear regulatory bodies to oversee plant safety. Figure 1 shows the type and location of the 60 Soviet-designed reactors operating in the Newly Independent States and in central and eastern Europe.

[3]The containment structure, generally a steel-lined concrete dome-like structure, serves as the ultimate barrier to the release of radioactive material in the event of a severe accident.

Figure 1: Operational Soviet-Designed Nuclear Power Plants, as of July 1996



Note: Numbers in parentheses show the total reactors in the country, and numbers within symbols show the number of reactors of a specific type at a site.

Sources: DOE and GAO.

Several federal agencies share responsibility for the U.S. nuclear safety assistance program. The Department of State provides overall policy guidance, with assistance from the U.S. Agency for International Development (USAID). DOE is responsible for implementing projects involving training, operational safety, and safety-related equipment. Three of DOE's national laboratories support the program. The Pacific Northwest National Laboratory provides the primary management support, and along with the Brookhaven National Laboratory and the Argonne National Laboratory, manages specific safety projects. NRC is responsible for assisting the recipient countries' nuclear regulatory organizations.

Goals of U.S. Safety Assistance Have Remained the Same, but Scope of DOE's Program Has Expanded

The goals of the U.S. safety assistance program have remained the same since its inception—encouraging the shutdown of the highest-risk Soviet-designed nuclear power reactors and reducing the risk of accidents. However, none of these reactors have been closed, and one has been restarted. In addition, DOE's portion of the program has evolved and expanded to cover a broader range of safety projects.

No High-Risk Reactors Have Been Closed

Although the United States remains committed to securing the closure of the highest-risk nuclear power reactors, none have been closed. Furthermore, Armenia recently restarted one of its VVER 440 Model 230 reactors. Department of State officials told us that progress has been made in getting closure agreements for some reactors in Bulgaria, Lithuania, and Ukraine, but these officials also recognize that it may be difficult for these countries to meet these agreements on a timely basis. For example, Bulgaria has agreed to a phased shutdown of its highest-risk reactors by 1998 as adequate replacement energy, such as hydroelectric power, becomes available. Department of State officials said the closure date will probably be delayed by 2 or 3 years because, among other things, the pace of economic reform in Bulgaria has been slow.

In 1995, the G-7 nations (major industrialized nations) and Ukraine signed an agreement that includes Ukraine's commitment to close the Chornobyl nuclear power reactor by 2000. State Department and USAID officials said that successful implementation of the agreement hinges on Ukraine's progress in reforming the energy sector. Such progress is key to continuing the international financial assistance that may ease the impact of closure.

DOE, national laboratory, and Department of State officials acknowledge that many of the highest-risk reactors may continue to operate for several more years. Many factors complicate U.S. and western nations' efforts to obtain early closure of the highest-risk reactors, including (1) a lack of consensus, particularly among Russian nuclear safety experts, about the safety of their reactors; (2) concerns about the social and economic well-being of workers who would be displaced if reactors were closed; (3) a commitment to expanding nuclear power, particularly in Russia, to meet future energy needs; and (4) the need to obtain financing to support the development of replacement energy.

DOE's Director of the Office of Nuclear Energy, Science, and Technology said that Russia does not intend to close its highest-risk reactors for many years, and he believes that the United States should continue to provide assistance so that these reactors can operate as safely as possible until they are closed. Department of State and USAID officials also noted that it is sound policy to continue to reduce the risks of accidents at the highest-risk reactors.

In keeping with this policy, DOE plans to increase technical assistance to RBMK plants, including Chornobyl. The Chornobyl initiative is part of a multinational effort to provide safety upgrades that can be completed quickly. DOE is planning to spend about $13.8 million at the Chornobyl nuclear power plant, including upgrades for fire safety at one of the two operating reactors and instituting operational safety and training programs for both reactors.

In total, DOE plans to spend about $33 million for safety parameter display systems for plants with RBMK reactors. This system provides information, which is displayed on a monitor, to operators about plant conditions that are important for safety. In addition, DOE plans to spend about $8.5 million on a project to transfer western maintenance practices, training methods, and technology to staff at RBMK reactors.[4] DOE officials noted that the project will not extend the life of the RBMK reactors but will improve safety.

Our review of the RBMK maintenance initiative indicates that the repair or replacement of any component that a plant relies on would support the plant's continued operations. While these efforts will not by themselves extend the lifetime of the plant, they will serve to keep the plant's

[4]Specific projects include laser alignment equipment and special lathes to prepare large pipes for welding, as well as the technology and training associated with this equipment.

components in service longer. In 1993, the Chairman of NRC at that time said that it is difficult to draw a fine line between short-term safety improvements and upgrades that could encourage a plant's operator to think in terms of long-term operations.

Scope of DOE's Program Has Expanded

DOE's program was initially viewed as short- to mid-term, totaling between $25 million and $40 million, with additional funding planned of about $100 million.[5] However, DOE's portion of the program has grown because of the complexities and challenges involved in improving the safety of Soviet-designed plants. As of March 1996, DOE had initiated more than 150 projects in this program, and DOE's Director of the Office of Nuclear Energy, Science, and Technology told us that approximately $500 million would be required over the next 10 years to address the program's long-term safety and training needs. (According to Department of State and USAID officials, this estimate has not been agreed upon by other U.S. government agencies participating in the program.) In contrast, NRC views its regulatory assistance program, totaling about $28 million, as limited in terms of its size and scope.

DOE and Pacific Northwest National Laboratory officials said that while it remains important to address short-term safety problems at the plant level, it is equally important to approach safety at a systemic level to help bring about sustainable improvements. As a result, the program has placed increased emphasis on transferring U.S. technology and encouraging the recipient countries to analyze and fix their own safety problems. According to DOE officials, the technology transfer aspect of the program is having a positive impact.

DOE has developed a short- to mid-term plan that provides an overview of the program's objectives, performance measurements and ongoing projects. Although they plan to do so, DOE officials have not yet established a long-term plan linking the program's objectives to measurable goals or providing a date for meeting those goals. As a result, it is unclear how DOE will demonstrate when and how it has achieved the program's goals. It is also unclear, without such a plan, when the program will end. According to DOE's Deputy Associate Director for International Nuclear Safety, the 10-year approach is based on an intuitive view of the time needed to complete the program's overall objectives. DOE officials told us in September 1996 that the agency has begun to develop a plan that will link objectives to goals and set a date for achieving these goals.

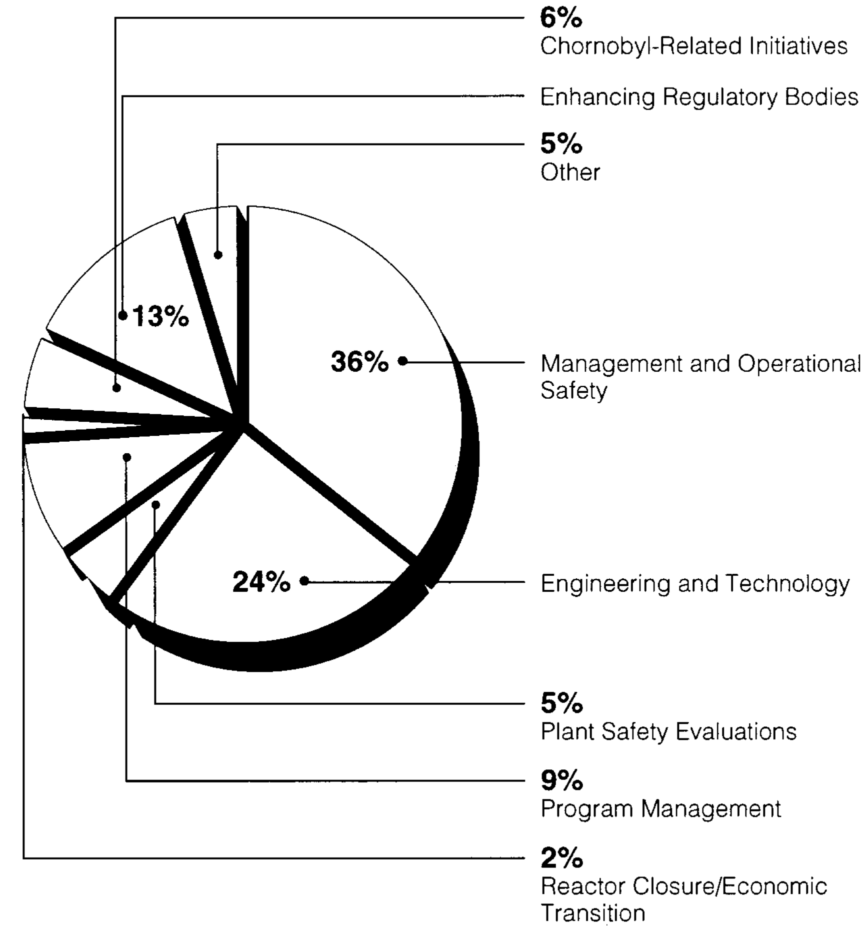
[5] In our 1994 report, we noted that, as of June 30, 1994, DOE planned to spend about $134 million.

U.S. Nuclear Safety Assistance Program Has Received $208 Million

DOE and NRC have received $208 million for their programs in the Newly Independent States and countries of central and eastern Europe. USAID has provided about 80 percent of the total funds received through various interagency agreements with DOE and NRC. The remainder of the funds has come from DOE ($30 million) and the Department of Defense ($11 million). Beginning in fiscal year 1996, DOE began receiving direct appropriations for the program but is still obtaining some funds from USAID for special projects, such as Chornobyl. (App. I provides greater detail on DOE's and NRC's costs for the safety assistance program and fig. I.1 provides information about the Chornobyl project.)

The U.S. nuclear safety program has focused on several types of assistance, including management and operational safety, engineering and technology (including fire safety and other plant-specific improvements), plant safety evaluations, and regulatory enhancements. Operational improvements can be implemented at all plants regardless of reactor type. Plant-specific measures are generally directed toward reactors such as the oldest RBMKs and VVER 440 Model 230s. As figure 2 shows, the greatest percentage of the funds—36 percent—has or will be spent on management and operational safety, which includes training and safety procedures.

Figure 2: Planned and Actual Distribution of U.S. Funding of $208 Million for Nuclear Safety Assistance Program, as of March 31, 1996



Sources: Pacific Northwest National Laboratory and NRC.

As of March 31, 1996, DOE had obligated $119.2 million and had spent $78.3 million of the $180.1 million it had received. NRC had obligated $16.5 million and spent $11 million of the $27.9 million received. (See table I.1). Of the combined agencies' expenditures, $42.2 million was for nuclear safety equipment and other products. More than half of the $42.2 million was for training or training-related items, such as simulators.[6] Less than one-third of this amount was for safety-related hardware, such as fire safety or other plant-specific equipment. (See fig. I.2). Other program-related expenditures were for labor, travel, overhead, and other costs. (See tables I.2 and I.3).

DOE, NRC, and Pacific Northwest National Laboratory officials recognize that their obligation and expenditure rates for their respective programs—particularly in Russia and Ukraine—have lagged over time. They stated, however, that several factors have contributed to the delays, including (1) concerns about nuclear liability in the United States that led to a change in DOE's program management and stalled many projects;[7] (2) logistical problems with establishing assistance programs in Russia and Ukraine; (3) the need to develop working relationships with Russian and Ukrainian organizations, some of which have experienced significant turnover and/or attrition of key personnel; and (4) procurement delays in the United States.

DOE, national laboratory, and NRC officials noted concerns about their programs' unobligated balances. As of March 31, 1996, DOE's unobligated balance was about $61 million and NRC's was about $11 million. DOE intended to obligate all currently unobligated funds by September 30, 1996.[8] While NRC has obligated 88 percent of its funds for central and eastern Europe, its obligation rates for Russia and Ukraine are significantly lower. NRC expects to obligate its available funds, primarily for Russia and Ukraine, over the next few years.

[6]A simulator replicates the plant's conditions and is used to train the plant's operators.

[7]In 1994, Associated Universities, Inc., the organization that operates the Brookhaven National Laboratory for DOE and had been responsible for managing the program, decided not to undertake certain safety-related projects in the Newly Independent States because Brookhaven did not have adequate liability protection. During this period, U.S. contractors and others expressed significant concern about performing nuclear safety-related work in these countries without liability protection. Subsequently, DOE transferred the responsibility for program management from Brookhaven to the Pacific Northwest National Laboratory.

[8]As of July 28, 1996, DOE had obligated $156.4 million and spent $96.6 million of the $180.1 million it had received, leaving an unobligated balance of $23.7 million. As of July 31, 1996, NRC had obligated $20.3 million and spent $13.1 million of the $27.9 million received, leaving an unobligated balance of $7.6 million.

Status of 13 DOE and NRC Safety Projects in Russia and Ukraine

Of the 13 safety projects we reviewed, 11 have been delayed in their implementation and one has been completed. Projects have been delayed largely because of difficulties in getting U.S.-supplied equipment cleared through Russian and Ukrainian customs officials. While some of these difficulties continue, several projects are moving forward. Despite the recent progress, it is too early to assess the impact of these projects on safety.

Eleven of the 13 safety projects implemented by DOE and NRC have been delayed, and 3 are more than 2 years behind schedule. At the time of our review, one project, a study of nuclear energy options for Russia, had been completed. The study concluded that, among other things, it was in Russia's economic interest to upgrade some of its operating nuclear power reactors and to close and decommission some of its higher-risk reactors. (See app. II for a summary of the projects and the reasons for the delays).

A number of factors have delayed the implementation of these projects, including (1) problems with customs, (2) foreign officials' imposition of unanticipated and/or burdensome requirements, and (3) the inability of Russia and Ukraine to provide adequate financial support for some projects. Despite these impediments, several projects are now progressing more quickly. (DOE's projects are discussed in detail in app. III, and NRC's are discussed in app. IV.)

For the 13 projects we reviewed, DOE has been requested to pay at least $505,000 in unanticipated costs. These costs include

- $442,000 to replace or refurbish unusable simulator parts in Ukraine,
- $34,000 to store U.S. equipment in European warehouses pending the resolution of customs problems in Russia,
- $26,000 for airfare to enable Ukrainians working on a year-long simulator project in the United States to return to Ukraine or to have their spouses visit them in the United States, and
- $3,000 to the Ukrainian customs organization for fees to authorize the release of equipment.

Customs Problems in Russia and Ukraine

In 6 of the 13 safety projects we reviewed, Russian and/or Ukrainian customs officials did not release U.S. equipment to the nuclear power plants in a timely manner. Under the terms of agreements that the United States entered into with Russia and Ukraine, this equipment is to enter into these countries duty-free.[9] Local customs officials in Russia and Ukraine have not consistently recognized the duty-free status of this equipment. Department of State and USAID officials told us that other U.S. assistance programs in the Newly Independent States have experienced similar problems. Customs problems have included the following:

- Russian customs officials impounded 100 fire suits and related fire safety equipment, valued at $110,000, until customs duties were paid. This equipment was destined for the Smolensk nuclear power plant. Since no duties were paid, customs officials turned the equipment over to a Russian court, which donated the equipment to a local fire company. Realizing it could not use the equipment, the fire company eventually sent the gear to the nuclear power plant, about 1 year after it had been shipped to Russia.
- A U.S. contractor placed emergency batteries and related equipment in a storage facility in the Netherlands for several months pending the resolution of customs problems in Russia. The shipper requested the reimbursement of about $11,300 for storage costs, but DOE had not paid these costs at the time of our review.
- Russian customs officials have been holding a sample high-temperature suit and related equipment, valued at about $26,000, for over 2 years. The equipment, which was examined by Smolensk nuclear power plant officials in May 1994, is no longer considered useful by DOE except for demonstration purposes. As a result, DOE has not pressed Russian authorities to release it. No customs duties or storage fees have been imposed.
- Fire-retardant material, valued at $23,650, was stored in Finland for several months pending the resolution of customs problems. The shipper has claimed about $23,000 in storage costs, and this claim is being reviewed by the Pacific Northwest National Laboratory.

The Department of State's Senior Coordinator for Nuclear Safety Assistance said that customs problems have been raised with senior-level U.S. and Russian officials. Customs difficulties have been assigned to the Science and Technology Committee of the Gore-Chernomyrdin Commission for resolution.[10] The Vice President has repeatedly mentioned his concerns to Russian Prime Minister Chernomyrdin, and both DOE and

[9]The two agreements are the "Agreement Between the Government of the United States of America and the Government of Ukraine Regarding Humanitarian and Technical Economic Cooperation" (May 7, 1992), and the "Agreement Between the Government of the United States of America and the Government of the Russian Federation Regarding Cooperation to Facilitate the Provision of Assistance" (Apr. 4, 1992).

[10]The Commission was created in 1993 to overcome trade barriers in the energy sector but has expanded into other areas, including business development, space, science, and technology.

the Department of State have attempted to find a generic solution to the customs issue. However, pending such a resolution, case-by-case arrangements will still be required.

Recently, DOE and Pacific Northwest National Laboratory officials have focused greater attention on resolving customs problems. In February 1996, DOE and Ukrainian authorities agreed to a standardized process under which nuclear safety-related equipment would be cleared duty-free by customs in Ukraine. Laboratory officials said that some equipment had recently been shipped successfully to Russian plants using the U.S. Embassy in Moscow to facilitate the process, although these officials do not consider this approach to be a long-term solution. Some U.S. industry officials also noted that customs problems have decreased in recent months.

Because standardized customs procedures do not yet exist in either Russia or Ukraine, Pacific Northwest National Laboratory officials recognize that problems may continue to occur. These officials noted that their representative in Russia does, among other things, help resolve customs problems by working with Russian officials. Although the Pacific Northwest National Laboratory has a representative in Ukraine, his responsibilities are narrowly defined, and he does not routinely monitor customs issues. A Laboratory official said that the Ukraine representative's position may be expanded to more closely resemble the responsibilities of the program's representative in Russia.

In addition to customs problems, other factors have contributed to delays affecting 5 of the 13 projects we reviewed. For example, DOE's project to assist Russia in developing emergency operating instructions[11] at a pilot nuclear power plant was delayed, in part, because the Russian organizations responsible for approving the instructions have been slow to act and have not given the project priority status. Although the instructions were drafted in 1992, a lengthy process of verification, validation, training, and regulatory approval delayed the implementation of a partial set of instructions until mid-1996. In another case, Russian authorities insisted that some U.S. fire safety equipment planned for shipment to the Smolensk plant had to be tested and certified in Russia. This equipment had already been approved for U.S. nuclear power plants. Testing of the equipment was delayed for several months because of

[11]Emergency (symptom-based) operating instructions are designed to (1) specify the operator's actions in response to the plant's changing conditions, (2) allow the operator to stabilize the reactor without having to first determine the cause for the changing conditions, and (3) contribute to faster decision-making.

disagreements over funding. During this period, Russian authorities refused to allow the U.S. contractor to visit the plant until the matter was resolved.

A few U.S. contractors told us that DOE and the Department of State have not always been aggressive enough in helping resolve problems. In the cases of the emergency operating instructions and the fire safety equipment for the Smolensk plant, these contractors believed that DOE should have been more active in working with the appropriate Russian organizations to help resolve project delays sooner. One contractor noted that higher-level DOE officials needed to work more closely with key Russian officials to demonstrate the U.S. government's commitment to the projects' success. He noted that a key DOE nuclear safety official helped move the emergency operating instruction project forward after he had discussed the project with Russian officials from Rosenergoatom, the organization responsible for most nuclear power plants' operations in Russia.

Concerns With Cost-Sharing Arrangements

In 3 of the 13 projects, Ukraine and Russia have been unable to adequately finance or support their share of the project. For example, a full-scope simulator for the Khmelnytskyy nuclear power plant in Ukraine, valued at $12.7 million, has been delayed partly by the plant officials' inability to fulfill their commitments. As part of the project, the plant had agreed to provide certain components to be integrated into the simulator. However, the parts the plant provided were corroded. DOE paid for the replacements. In addition, the plant-supplied control room panels did not match the panels needed for the simulator; DOE paid for their modification as well.

The simulator project—as well as other projects for which the United States has agreed to cover additional costs—raises questions about the ability of host countries to meet commitments in other ongoing and planned cost-sharing projects for the safety program. For example, other simulator projects for Russia and Ukraine are being developed on a cost-sharing basis with DOE. The total estimated DOE contribution to these simulator projects is about $24 million; Ukraine's contribution is about $12 million; and Russia's contribution is about $7.5 million. DOE's simulator project manager said that some of the recipient countries' contributions will be "in-kind" contributions of labor, rather than financial outlays. However, he said that DOE recognizes that these projects are risky and that DOE may have some additional costs associated with them.

In October 1994, a USAID Inspector General's report raised similar concerns about cost-sharing ventures.[12] The report recommended that USAID, in coordination with DOE, ensure the development of procedures defining and documenting the role and use of U.S. government funding vis-a-vis host countries' contributions. According to DOE, the work plans for each project now include a description of the host country's expected contribution, which in many cases covers labor costs.

Several Projects Are Progressing Despite Delays

Despite delays, some projects have shown results because the pace of implementing a number of these safety projects has accelerated in recent months. For example, DOE and Brookhaven officials told us that the cadre of trainers at the Balakovo training center in Ukraine has grown from less than 10 to about 70 since the project began and that the plant's management is committed to the training program. In another project, NRC has worked closely with Russia's nuclear regulatory body, Gosatomnadzor, to develop a legislative basis for nuclear regulation and legal enforcement. NRC and Gosatomnadzor officials view this initiative as a significant first step toward the creation of an independent nuclear regulatory body in Russia. Furthermore, we were told that a significant amount of fire safety equipment has recently been delivered and installed at the Zaporizhzhya nuclear power plant in Ukraine and emergency power equipment has recently been installed at the Kola plant in Russia.

It Is Too Early to Assess the Impact of Selected Projects on Improved Safety

It is too soon to assess the extent to which the projects we reviewed are improving safety in Russia and Ukraine because most of these projects have not been completed. However, DOE, NRC, and national laboratory officials—as well as Russian and Ukrainian officials we met with—believe that the projects are beneficial. For example, DOE officials believe the fire safety equipment will reduce the likelihood of fires and improve detection and fire-fighting capabilities. A Russian official from the Smolensk nuclear power plant told us that the U.S. fire suits have increased fire fighters' confidence.

DOE officials said that they are attempting to measure safety improvements and to establish meaningful performance measures for the program. However, they said that the impact on plant safety of training, procedures, and changes in the safety culture is not clearly measurable. DOE's Director, Office of Nuclear Energy, Science and Technology and officials at the

[12] Audit of the Department of Energy's Nuclear Safety Technical Assistance Activities in Russia and Ukraine, Regional Inspector General for Audit, USAID (Oct. 7, 1994).

Pacific Northwest National Laboratory said that the lack of reliable baseline safety data makes it impossible for DOE to quantify the extent to which safety has been improved. Laboratory officials believe that measurable safety improvements may take 2 to 5 years.

DOE has established performance measures that primarily gauge performance in the technical work areas of the program by accounting for the number of plants or plant operators carrying out various tasks or projects. However, DOE has not yet reported on the results of these specific measurements. The Pacific Northwest National Laboratory is also attempting to gauge the impact of its program by gathering anecdotal evidence of improvements in nuclear safety. NRC has established results-based measurements that will be used to evaluate its regulatory assistance program.

Conclusions

The U.S. nuclear safety assistance program has evolved into a longer-term effort than initially envisioned, but DOE has not yet developed a plan that reflects this effort. Although DOE has estimated that it will need $500 million over the next 10 years, it has not articulated how it will achieve its objectives over this period. DOE's development of such a plan—which would link the program's goals with anticipated costs, outcomes, and time frames—would go a long way towards gauging how the Department's assistance is contributing to the improved safety of Soviet-designed reactors. It would also serve to provide a better estimate of how much assistance is required to meet the program's objectives.

The U.S. nuclear safety program has faced many challenges and impediments, such as the lack of a standardized customs process in Russia and Ukraine. While DOE has taken a more active role in resolving customs matters, this problem persists, contributes to delays, and increases the program's costs. The Pacific Northwest National Laboratory has placed a program representative in Russia who helps resolve customs problems. Because numerous customs problems have occurred in Ukraine, we believe that a Laboratory representative in Ukraine could provide similar program assistance.

Recommendations to the Secretary of Energy

To improve the management of the nuclear safety assistance program, we recommend that the Secretary of Energy take the following actions:

- Develop a strategic plan that (1) clearly links the program's goals and objectives to performance measurements, (2) provides well-defined time frames for completing the program, and (3) projects the anticipated funds required to meet the program's specific objectives, including the estimated U.S. contributions to cost-sharing arrangements that take into account the recipient countries' ability to realistically meet resource commitments.
- Facilitate the timely and duty-free delivery of U.S. safety equipment to nuclear power plants in Ukraine. Specifically, the Pacific Northwest National Laboratory's in-country representative in Ukraine should, as part of this position's assigned duty, work with the appropriate government authorities to resolve customs problems should the position assume broader responsibilities in the future. Part of this monitoring responsibility could include periodic visits to the nuclear power plants in Ukraine.

Agency Comments

We provided copies of a draft of this report to the Departments of Energy and State, USAID, and NRC. The Department of State and NRC generally agreed with the report's findings and provided clarifying information that we have incorporated into our report, as appropriate.

DOE and USAID provided written comments. DOE disagreed that the U.S. assistance program posed a dilemma because it may encourage the continued operation of the same reactors that the United States wants to see closed as soon as possible. DOE noted that the U.S. equipment being provided does not extend the life of the reactors. We did not assert that the equipment would extend the operating life of the reactors, but we believe that certain types of equipment could be used to support the continued operation of higher-risk nuclear power plants. For example, DOE's RBMK maintenance initiative provides the equipment, training, and technology that enables the plant's components to remain in service longer, thus supporting the plant's continued operations while improving plant safety. (See app. VI for DOE's comments and our response.)

USAID noted that our report (1) understated the overall level of progress being made by the U.S. assistance program and (2) gave the impression that no progress is being made toward obtaining the closure of the highest-risk Soviet-designed reactors. Regarding the first point, our report noted that several projects in our sample had made progress, resulting in, for example, the installation of safety-related hardware. However, we also noted that it was premature to assess the impact of these projects because only one had been completed. Regarding the second point, our report provided several examples of closure commitments that have been made but also stated that it will be difficult for the countries to meet specific closure dates. We also noted that, to date, no reactors have been closed, and one was recently restarted. (See app. VII for USAID's comments and our response.)

Scope and Methodology

To address our objectives, we interviewed officials and obtained documentation from the Department of State, USAID, DOE, NRC, and the Brookhaven and Pacific Northwest National Laboratories. We also met with some government officials and nuclear power plant personnel from Russia and Ukraine. We reviewed 13 of approximately 196 ongoing DOE and NRC nuclear safety projects to determine how they are being implemented and are contributing to improved nuclear safety. Agency officials agreed that our selection included projects that represent the safety program's highest priorities. Our scope and methodology are discussed in detail in appendix V.

We performed our review from January 1996 through August 1996 in accordance with generally accepted government auditing standards.

We plan no further distribution of this report until 15 days from the date of this letter unless you publicly announce its contents earlier. At that time, we will send copies of this report to other interested congressional committees, the Secretaries of State and Energy, the Chairman of NRC, the Administrator of USAID, the Director of the Office of Management and Budget, and other interested parties. We will also make copies available to others on request.

Please contact me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix VIII.

Sincerely yours,

Victor S. Rezendes
Director, Energy, Resources,
and Science Issues

Contents

Figures

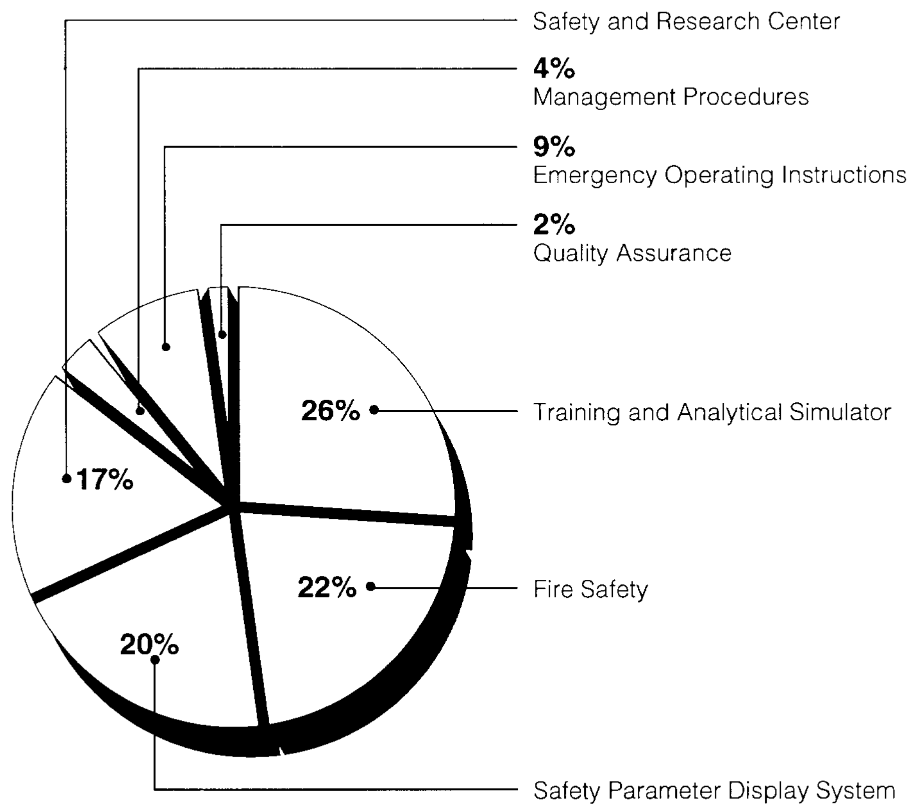
Abbreviations

ANL	Argonne National Laboratory
BAO/ORNL	Brookhaven Area Office and Oak Ridge National Laboratory
BNL	Brookhaven National Laboratory
CH	Chicago Area Office
DOE	Department of Energy
GAN	Gosatomnadzor
GAO	General Accounting Office
INPO	Institute of Nuclear Power Operations
Minatom	Russian Ministry of Atomic Energy
NRC	Nuclear Regulatory Commission
REA	Rosenergoatom
PNNL	Pacific Northwest National Laboratory
SAIC	Science Applications International Corporation
USAID	U.S. Agency for International Development

DOE's and NRC's Nuclear Safety Assistance Costs

This appendix provides detailed information on the Department of Energy's (DOE) and the Nuclear Regulatory Commission's (NRC) planned and actual costs for the U.S. nuclear safety assistance to improve the safety of Soviet-designed nuclear reactors.

Figure I.1: Planned Distribution of Funds Totaling $13.8 Million for DOE's Chornobyl Project



Source: DOE.

Table I.1: Obligations and Expenditures for DOE's and NRC's Safety Assistance Programs, as of March 31, 1996

Dollars in thousands

Agency and recipient	Funds received	Funds obligated[a]	Funds expended	Percent of funds received and obligated	Percent of funds received spent
DOE					
Russia	$101,294	$ 61,619	$37,388	61	37
Ukraine	64,006	47,879	34,200	75	53
CEEC[b]	14,750	9,711	6,701	66	45
Subtotal	**$180,050**	**$119,209**	**$78,289**	**66**	**43**
NRC					
Russia	$ 10,650	$ 5,247	$ 3,430	49	32
Ukraine	11,570	6,199	2,991	54	26
CEEC[b]	5,748	5,058	4,616	88	80
Subtotal	**$ 27,968**	**$ 16,504**	**$11,037**	**59**	**39**
Total	**$208,018**	**$135,713**	**$ 89,326**	**65**	**43**

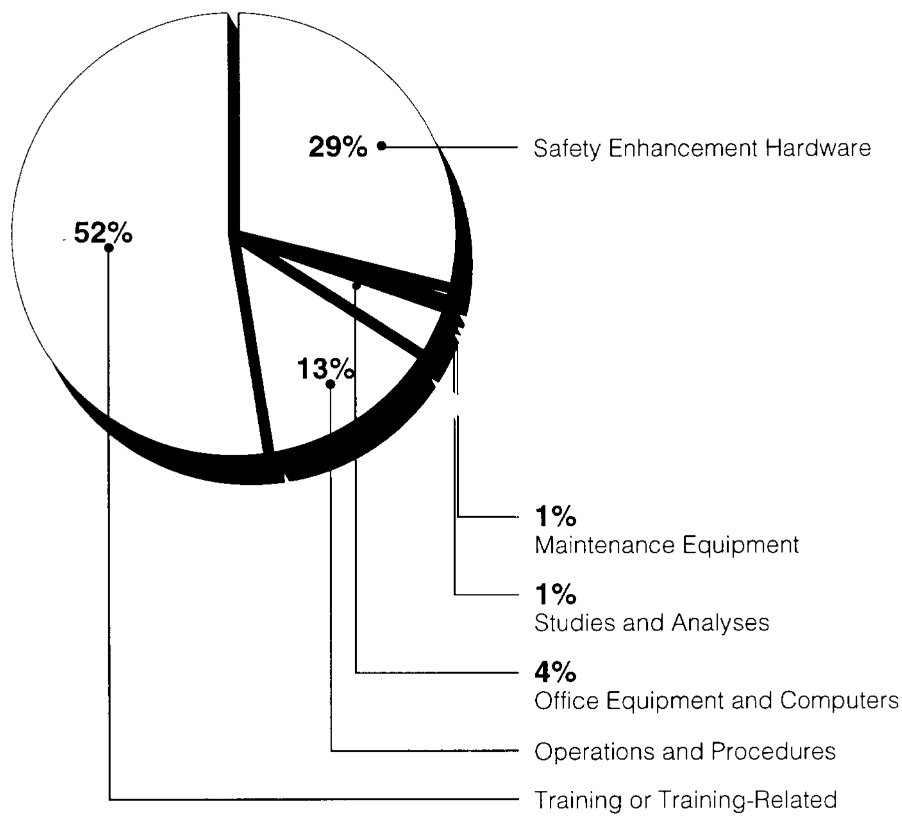
Note : Does not include U.S.contributions to the Nuclear Safety Account totaling $25 million. This account is administered by the European Bank for Reconstruction and Development. It also does not include $300,000 for NRC projects in Kazakhstan and Armenia.

[a]Occurs when a definite commitment has been made or a legal liability is incurred.

[b]Central and Eastern European Countries.

Sources: Pacific Northwest National Laboratory (PNNL) and NRC.

Figure I.2: DOE's and NRC's Cumulative Expenditures Totaling $42.2 Million for Nuclear Safety-Related Equipment and Products



Notes: Includes expenditures for equipment that has either been delivered or authorized for shipment as of Mar. 31, 1996. Does not include labor, travel, and other direct and overhead costs for the engineering and support services to specify, acquire, and deliver these products. Includes $2.6 million for RBMK-related expenditures.

Sources: PNNL and NRC.

Table I.2: DOE's Cumulative Expenditures for the Nuclear Safety Assistance Program, as of March 31, 1996

Dollars in thousands

	DOE Activity							
Element of cost	**DOE**	**PNNL**	**BNL**	**ANL**	**CH**	**BAO/ORNL**	**Total**	**Percent of total**
Labor[a]	$0	$4,157	$5,142	$178	$0	$41	$9,518	12
Travel[b]	480	888	1,861	170	0	6	$3,405	4
Materials/subcontracts[c]	5,856	9,788	20,730	2,664	8,166	0	$47,204	60
Other direct costs[d]	1,020	1,196	3,471	85	0	0	$5,772	7
Overhead[e]	0	5,323	6,740	328	0	0	$12,391	16
Total	**$7,356**	**$21,352**	**$37,944**	**$3,425**	**$8,166**	**$47**	**$78,290**	**99**

Legend:

DOE - DOE Headquarters Activity
PNNL - Pacific National Northwest Laboratory
BNL - Brookhaven National Laboratory
ANL - Argonne National Laboratory
CH - Chicago Area Office
BAO/ORNL - Brookhaven Area Office and Oak Ridge National Laboratory

Note: Total does not equal 100 percent due to rounding.

[a]Includes salaries, wages, and pensions that are directly chargeable to the international nuclear safety program. DOE headquarters' employees' salaries are not charged directly to the program.

[b]Includes travel and per diem costs—foreign or domestic—of DOE and laboratory officials. Does not includes travel and per diem costs of foreign nationals under the program; these costs are included in "materials/subcontracts."

[c]Includes directly applicable purchase orders, subcontracts, and consulting services. Contractor labor, travel, and overhead charges are included in this category. Also included in this amount is $38.8 million in safety-related equipment and products.

[d]Includes the costs of certain centralized services, including translation of documents.

[e]Includes charges for organizational overhead, general and administrative expenses, and service assessments.

Source: PNNL.

Table I.3: NRC's Cumulative Expenditures for the Nuclear Safety Assistance Program, as of March 31, 1996

Dollars in thousands

Expenditure	Amount
Contractor personnel	$4,918
Travel[a]	2,792
Training	193
Equipment	504
Computer codes[b]	2,600
Other	29
Total	**$11,036**

Notes: NRC headquarters employees' salaries are not charged directly to the program. The expenditures in this table are different than the NRC expenditures shown on table I.1 due to rounding.

[a]Includes travel and per diem expenditures of NRC and foreign national officials.

[b]Transfer and training in the use of computer programs used by NRC for safety analysis and participation in user groups.

Source: NRC.

Summary of 13 DOE and NRC Safety Projects and Primary Reasons for Delays

Safety projects	Project value [a]	Project status	Liability	Customs problems	Other impediments[b]	Cost-sharing
Kola Battery Upgrades (Russia)	$3.5	Delayed. Plan to complete in 9/1996.	Yes	Yes	No	No
Kursk Battery Upgrades (Russia)	2.1	Delayed. Plan to complete in 12/1996.	Yes	No	No	No
Smolensk Fire Protection (Russia)	4.5	Delayed. Plan to complete in 11/1996.	Yes	Yes	Yes	No
Zaporizhzhya Fire Protection (Ukraine)	1.8	Delayed. Plan to complete in 12/1996.	Yes	No	No	No
Emergency Operating Instructions	13.5	Delayed. Plan to complete in 12/1998.	No	No	Yes	Yes
Zaporizhzhya Dry Cask Storage (Ukraine)	6.6	Delayed. Plan to complete in 9/1996.	No	Yes	No	Yes
Khmelnytskyy Full-Scope Simulator (Ukraine)	12.7	Delayed. Plan to complete in 11/1997.	No	Yes	Yes	Yes
Balakovo Training Center (Russia)	9.7	Plan to complete in 6/1997.	No	Yes	No	No
Joint Nuclear Study (Russia)	2.0	Completed in 6/1995.	No	No	Yes	No
Legislative Basis for Nuclear Regulation (Russia)	.6	Delayed. Plan to complete in 12/1996.	No	No	No	No
Incident Response Center (Russia)	1.5	Delayed. Plan to complete in 9/1997.	No	Yes	No	No
Analytical Simulators (Russia and Ukraine)	6.0[c]	Delayed. Plan to complete in 6/1999.	No	No	No	No
Probablistic Risk Assessments (Russia)	2.5	Delayed. Plan to complete in 5/1998.	No	No	Yes	No

[a]Project values expressed in millions of dollars.

[b]Includes the imposition of burdensome requirements and/or lack of “buy-in” by foreign authorities.

[c]Total planned value of the project.

Source: Based on data provided by DOE and NRC.

Department of Energy Safety Assistance Projects

This appendix discusses nine nuclear safety projects we reviewed that DOE has completed or is implementing in Russia and Ukraine. These projects, which have a total value of about $56 million, include a training center in Russia, a full-scope simulator in Ukraine, emergency power systems in Russia, fire safety equipment in Russia and Ukraine, spent fuel storage in Ukraine, emergency operating instructions for Soviet-designed nuclear reactors, and a study of nuclear energy options for Russia.[1]

Training Center at the Balakovo Nuclear Power Plant

The Balakovo training center in Russia is one of the two regional training centers established by the 1992 Lisbon Initiative on Multilateral Nuclear Safety. The purpose of the training center is to teach a systematic approach to training—the measurable, performance-based training program used for U.S. nuclear power plant personnel—to Balakovo plant personnel. The systematic approach to training is used as a method to develop or improve training programs for operations, maintenance and other technical support personnel. DOE expects that this training approach will eventually be transferred from Balakovo to the other VVER-1000 designed plants in Russia.

Project Costs

As of March 31, 1996, DOE had allocated $9.4 million for the Balakovo training center and had obligated $9.7 million. About $4.3 million had been spent, as seen in table III.1.

Table III.1: Expenditures for Balakovo Training Center, as of March 31, 1996

Expenditure	Amount
Labor	$243,025
Travel	222,816
Subcontracts/materials	3,189,804
Overhead[a]	674,750
Total	**$4,330,395**

[a]Includes charges for organizational overhead, general and administrative expenses, and service assessments.

Sources: Brookhaven National Laboratory and Pacific Northwest National Laboratory (PNNL).

[1]Tables III.1-III.2, III.4-III.9, and III.11 reflect DOE's national laboratory expenditures. The category subcontractor/materials includes expenditures incurred by subcontractors, including travel, labor, and overhead.

Project Status

The Balakovo training center project was started in April 1993 and is expected to be completed by June 1997. However, training for other VVER 1000 plant operators in Russia may continue beyond 1997. According to DOE and Brookhaven officials and representatives from Sonalysts, Inc. (the U.S. contractor), no major delays have occurred in implementing the project because of the high level of cooperation from Balakovo plant management and Russian authorities.

By working cooperatively with Balakovo plant personnel, DOE, Brookhaven, and Sonalysts, Inc. developed 12 job-specific training courses and 6 general training courses for the plant. As of May 1996, 6 of the 12 job-specific training programs and 3 of the 6 general courses had been completed.

Along with the training, DOE is providing both course-specific equipment and equipment for the training center, such as circuit boards, soldering work stations, laser alignment equipment, computers, printers, and audiovisual equipment. Equipment shipped from the United States to the Balakovo training center has experienced some customs problems. According to the Brookhaven project manager, in one instance the plant paid a substantial amount to get a shipment of equipment out of customs storage. Two shipments of spare parts for a full-scope simulator for the training center, valued at $45,500, have been held in U.S. airport storage since August and September 1995 awaiting approval from Rosenergoatom (REA),[2] for shipment. However, this Brookhaven official told us that, more recently, some equipment had been shipped successfully to the plant by using the U.S. Embassy in Moscow to facilitate clearance. For example, about $22,000 in soldering equipment that had been held in storage in Helsinki, Finland, since July 1995, pending resolution of the customs issue, was delivered to the plant in April 1996.

DOE considers the Balakovo training center to be a success because of the plant management's commitment to the training. In a March 1996 letter to DOE, the Balakovo plant manager stated that the training program was a success because of the effective interaction between the Russian and U.S. sides and the fact that the training approach had been applied to specific conditions at the plant. According to the Brookhaven project manager, the size of the Balakovo training center staff has grown from less than 10 in 1992-93 to about 70 in 1996, and instructors' salaries are the same as plant operators. As of March 1996, about 600 personnel at Balakovo had been

[2]Rosenergoatom is the organization in Russia's Ministry of Atomic Energy that is responsible for all nuclear power plant operations in Russia, except for the Leningrad nuclear power plant.

trained on material developed with U.S. assistance. Plant personnel have also begun to develop training material for additional duty areas and to train other personnel. Approximately 5,000 plant personnel require job-specific training.

In a November 1995 meeting with DOE, officials from Russia's Ministry of Atomic Energy (Minatom) said that they were pleased with the training program at Balakovo and wanted to adopt the training method to other VVER-designed plants in Russia. In April 1996, Brookhaven's project manager met with Russian officials and agreed to a plan to transfer the training approach to other Russian plants. Because Balakovo does not have the resources to transfer the training approach to other plants, DOE agreed to continue to assist Russian organizations and Balakovo with additional training.

Full-Scope Simulator for Khmelnytskyy Nuclear Power Plant

The other regional training center in Khmelnytskyy, Ukraine, established by the 1992 Lisbon Initiative, will feature a computer-based simulator for the VVER-1000 reactor, as seen in figure III.1.

Figure III.1: Example of a Full-Scope Simulator

Source: PNNL.

DOE is purchasing a full-scope simulator for the Khmelnytskyy training center so that plant personnel can upgrade and maintain their operational skills in dealing with routine and abnormal events at the plant. DOE officials and representatives from S-3 Technologies, Inc. (the U.S. contractor) believe that the transfer of simulator technology to Ukrainian personnel will have long-term benefits. The simulator technology is being transferred to a Ukrainian team that will maintain and modify the Khmelnytskyy simulator and build and maintain simulators for the other nuclear power plants in Ukraine. As a part of this technology transfer, a Ukrainian company has learned how to manufacture control room panels, a key component of the simulator, that meet U.S. standards.

The United States and Ukraine are working together to develop the simulator. S-3 Technologies, Inc. is designing, developing, testing, and installing the simulator in Ukraine and is providing training and support to the technology transfer team. As a part of the simulator development activities, the Ukrainians agreed to provide plant data, control room panels, and instruments, and to host a U.S. team in Ukraine for about a year. Brookhaven National Laboratory subcontracted with a Ukrainian company to modify the control room panels for the simulator. The Ukrainians also agreed to construct a building at the Khmelnytskyy training center to house the simulator.

Project Costs

As of March 31, 1996, DOE had allocated $11.7 million for the simulator project against a total estimated cost of $12.7 million. It had obligated $11.7 million and had spent $8.5 million of this amount. Table III.2 shows these expenditures in greater detail. Most of the funding has come from the Department of Defense, which transferred $11 million to Brookhaven to build the simulator in November 1994. DOE allocated an additional $500,000 for development of the project specifications. Because of project delays and unanticipated costs, DOE has since added $1.2 million to the project.

Table III.2: Expenditures for Khmelnytskyy Simulator, as of March 31, 1996

Expenditure	Amount
Labor	$447,237
Travel	127,910
Subcontracts/materials	7,377,251
Overhead	555,688
Total	**$8,508,086**

Sources: Brookhaven National Laboratory and PNNL.

Included in these expenditures is $596,724 that DOE paid for travel, lodging, and other expenses for 22 Ukrainian technology team members who lived in the United States for approximately one year. (See table III.3.) Of that amount, $26,298 was for airfare that DOE or S-3 Technologies, Inc. paid for 12 Ukrainian spouses who traveled to the United States and 4 team members who traveled home, for about one month. According to a representative of S-3 Technologies, Inc., one member of the project team, a Ukrainian computer specialist, left the program to work for a U.S. computer firm and was replaced. PNNL officials, who authorized the payments, were not aware that the Ukrainian team member had left the project under these circumstances until we brought it to their attention. They noted, however, that they were led to believe that the team member had personal problems that caused his absence from the program.

Furthermore, these officials stated that no inappropriate payments were made to the team member.

Table III.3: Expenditures for Ukrainian Technology Transfer Team, as of March 31, 1996

Expenditure	Amount
Apartments, per diem, car rentals, health insurance	$487,522
Travel for team	80,321
Additional travel for spouses and team	26,298
Visas	2,583
Total	**$596,724**

Source: S-3 Technologies, Inc. and PNNL.

Project Status

The simulator project was originally expected to be completed by December 1996, and, according to DOE and Brookhaven project officials, is now expected to be completed by November 1997. Several events have contributed to project delays, including (1) a 9-month delay in receiving Department of Defense funds, (2) the reluctance of Khmelnytskyy plant management to provide complete and accurate plant data in a timely manner, (3) the unanticipated modification of Ukrainian-supplied control room panels, (4) the need to replace defective simulator instruments supplied by Ukraine, and (5) customs problems.

The Ukrainians have had difficulties in fulfilling their agreements in a timely manner. This has led to project delays and unanticipated costs. An S-3 Technologies representative told us that the Khmelnytskyy plant management was hesitant to release plant data to his company and had asked for payment for the data collection effort. S-3 Technologies eventually received the plant data without paying for it. Furthermore, the plant did not provide complete and timely delivery of the control room panels and instruments that are required for assembling the simulator. DOE paid $389,000 to modify the control panels. In addition, because the crates containing the instruments and switches had been stored outside for 3 years, the switches were rusted and needed to be replaced, at a cost of about $52,600 to DOE. DOE has also agreed to pay about $30,000 for lodging costs for the U.S. contractor personnel who will be living in Ukraine for one year. Ukraine had originally agreed to cover these costs as well.

Difficulties with customs have also contributed to delays in assembling the control room panels for the simulator. In a 1995 letter to DOE, an official with Ukraine's state-owned nuclear power utility said that clearance of certain equipment had been held up because representatives of the U.S. Agency for International Development(USAID) mission in Kiev were unaware that the deliveries were part of DOE's technical assistance program. In February 1996, the Khmelnytskyy plant's general director noted in a letter to Brookhaven National Laboratory that the simulator project would be jeopardized if the customs problems were not resolved. In February 1996, DOE signed a protocol with Goscomatom, Ukraine's nuclear power utility, to facilitate future deliveries of nuclear safety equipment from the United States to Ukraine. In January 1996, two shipments of simulator parts were delivered to a customs warehouse in Ukraine, but they were not released until U.S. officials visited the plant in April 1996. During this visit, DOE's project manager told us that he agreed to have S-3 Technologies pay customs fees of between $2,000 and $3,000 to release a third shipment of simulator equipment.

DOE and Brookhaven officials and representatives of S-3 Technologies are concerned that the training center building that will house the simulator will not be completed on time. During U.S. officials' July 1996 visit to the plant, Pacific Northwest National Laboratory representatives reported that the training center building would be completed in August 1996. The control panels are also expected to be completed and installed in August 1996.

About 16 to 18 S-3 Technology personnel will travel to the Khmelnytskyy plant in the fall of 1996 to integrate the simulator hardware with the software and to test and verify the simulator. The Khmelnytskyy team members will assist the U.S. contractors in testing the simulator in Ukraine. In addition, members of the technology transfer team representing Goscomatom will work at the Ukraine simulator support center in Kiev developing other simulators for Ukraine, such as one for the Rivne nuclear power plant.

Emergency Power Supply Equipment for Kola and Kursk Nuclear Power Plants

DOE is providing batteries and related equipment to improve the emergency power supply systems of the Kola and Kursk nuclear power plants in Russia.[3] The batteries are used to provide electricity so that safety systems can function during a power outage, and the performance of most nuclear power plant safety systems depends on the availability of emergency power. The equipment will replace existing Russian-manufactured batteries that are not enclosed and present

[3]DOE is providing the equipment to two VVER-440/230 units at Kola and one RBMK unit at Kursk.

potential safety hazards. In the case of Kola, the new batteries are seismically qualified and meet U.S. safety standards. At Kursk, batteries will be of two types: seismically qualified and commercial.

In both projects, the U.S. contractor, Burns and Roe, is responsible for developing specifications, purchasing and delivering the equipment, and monitoring equipment installation. The major pieces of equipment are being purchased in the United States. Figures III.2 and III.3 show existing batteries and U.S.- provided replacements.

Figure III.2: Batteries Currently Used at Kursk Nuclear Power Plant

Source: PNNL.

Figure III.3: U.S. Seismically Qualified Batteries for Kola Nuclear Power Plant

Source: PNNL.

Project Costs

DOE has allocated approximately $3.5 million for the Kola project and about $2.1 million for Kursk. As of March 31, 1996, DOE had obligated $3 million and spent about $2.9 million for Kola and had obligated $2.1 million and spent about $607,000 for Kursk. Tables III.4 and III.5 provide an analysis of expenditures for the two projects.

Table III.4: Expenditures for Emergency Power Supply Equipment at Kola Nuclear Power Plant, as of March 31, 1996

Expenditure	Amount
Labor	$18,274
Travel	1,966
Subcontracts/materials	2,936,327
Direct Costs	0
Overhead	17,798
Total	**$2,974,365**

Source: Brookhaven National Laboratory and PNNL.

Table III.5: Expenditures for Emergency Power Supply Equipment at Kursk Nuclear Power Plant, as of March 31, 1996

Expenditure	Amount
Labor	$1,249
Travel	0
Subcontracts/materials	604,678
Direct costs	0
Overhead	901
Total	**$606,828**

Source: Brookhaven National Laboratory and PNNL.

Project Status

DOE's project manager told us that both the Kola and Kursk battery upgrade projects were initially delayed for about one year because of Brookhaven's and U.S. contractors' concerns about nuclear liability. These concerns resulted in the transfer of overall program management from Brookhaven to Pacific Northwest National Laboratory.[4] The Kola project, started in 1994, was originally expected to be completed by July 1995. DOE currently estimates that the project should be completed by September 1996. After the initial delay, DOE has proceeded according to schedule and the manufacture of the batteries is to be completed by July 1996.

[4]The management of the emergency power supply equipment and fire safety equipment projects were also transferred at this time from Brookhaven to DOE.

Installation will be completed when the reactor goes off line temporarily for routine maintenance.

A representative from the U.S. contractor, Burns and Roe, noted that delays in the Kola project were also due to changes when the plant management decided to perform routine maintenance that forced the contractor to reschedule battery installation. The Kola project, like other projects we reviewed, also experienced customs problems, but these problems did not affect the project schedule, which had already been delayed. For example, in November 1995, equipment for the Kola project was shipped from the United States to Russia. As instructed by DOE, Burns and Roe held the equipment at a storage warehouse in the Netherlands pending resolution of customs issues. The equipment remained at the warehouse from November 1995 through early January 1996, when it was cleared for release and shipped to the plant. The warehouse charged the U.S. shipping agent $11,292 for storage fees, and DOE will be asked to reimburse the shipper for the fees.

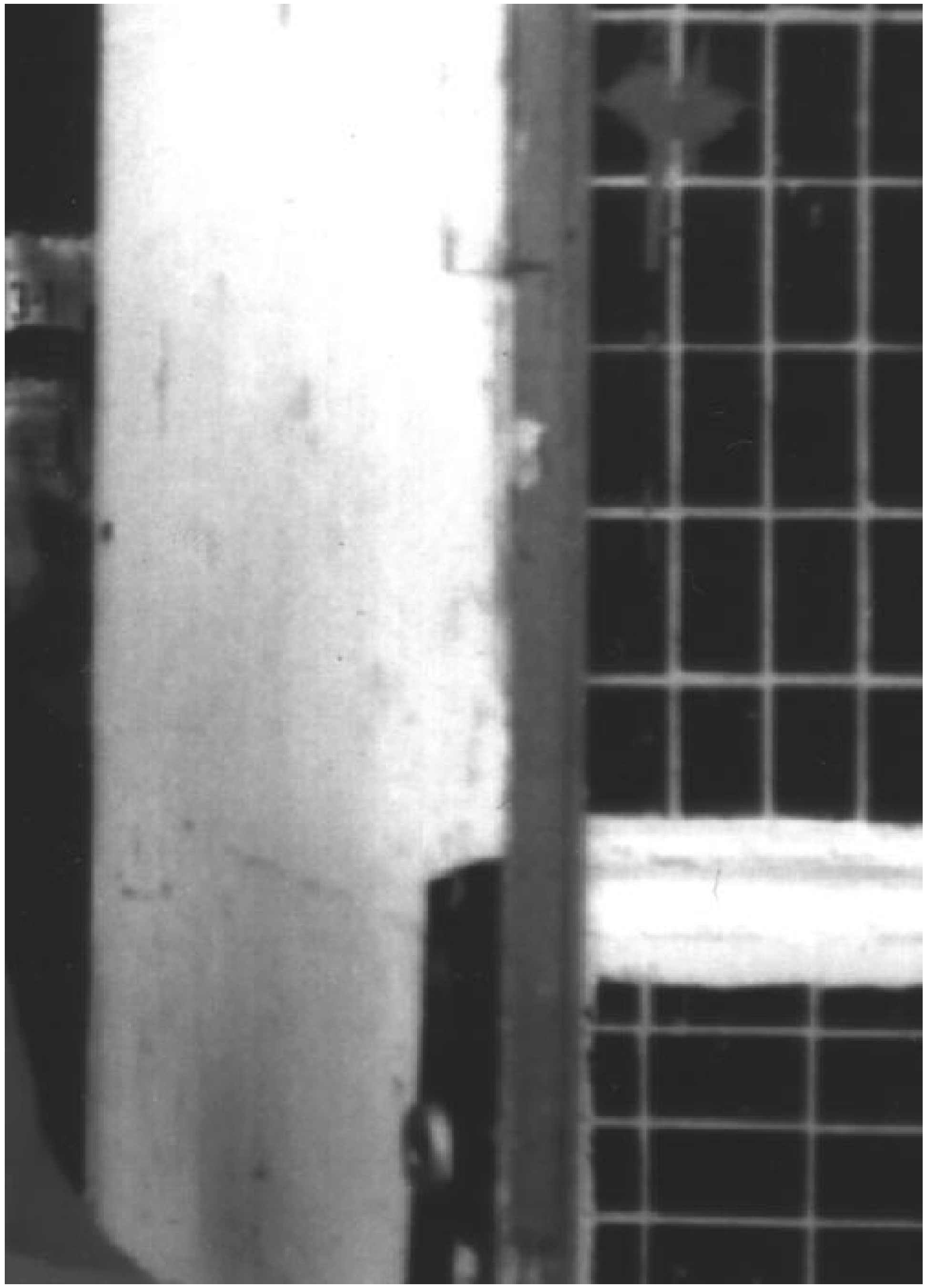
Despite these customs problems, according to the Burns and Roe representative, all of the Kola-related equipment has been delivered and the batteries for one of the units have been installed. This includes approximately $1.6 million for batteries, battery trays, and switchboards. Approximately $100,000 in similar equipment has been delivered to Kursk. The remainder of the equipment is scheduled for shipment in August 1996. DOE estimates that the Kursk project will be completed in December 1996.

Fire Safety Equipment for the Smolensk Nuclear Power Plant

DOE is providing fire safety equipment to the Smolensk nuclear power plant in Russia to reduce the risk of fires and minimize their effect should they occur.[5] Smolensk was selected as a pilot project by DOE in 1993, with the expectation that equipment would be delivered quickly to demonstrate the effectiveness of the U.S. safety program. In 1993, Brookhaven, which was initially assigned responsibility for project management by DOE, selected Bechtel Power Corporation to implement the project. Major items of equipment to be provided include fire suits, smoke detectors, fire doors, fireproofing materials, and radios. Figure III.4 shows an existing fire door at Smolensk and a sample replacement door is shown in figure III.5. Fire-fighting suits, already delivered to the plant, are shown in figure III.6.

[5]The Smolensk nuclear power plant has three RBMK reactors, all of which began operating between 1983 and 1990.

Figure III.4: Existing Wooden Fire Door at Smolensk Nuclear Power Plant



Source: PNNL.

Figure III.5: Prototype Metal Fire Door to Be Installed at Smolensk Nuclear Power Plant

Source: PNNL.

Figure III.6: Fire-Fighting Suits Provided to Smolensk Nuclear Power Plant

Source: PNNL.

Project Costs

The estimated value of the project is $4.5 million. As of March 31, 1996, $2.7 million had been obligated, and about $1.3 million had been spent, as shown in table III.6.

Table III.6: Expenditures for Smolensk Fire Safety Equipment, as of March 31, 1996

Expenditure	Amount
Labor	$57,603
Travel	4,306
Subcontracts/materials	1,173,313
Other Direct Costs	5,053
Overhead	82,205
Total	**$1,322,480**

Sources: Brookhaven National Laboratory and PNNL.

Project Status

Numerous factors have delayed implementation of the Smolensk fire safety project, including (1) nuclear liability concerns that led to changes in U.S. project management, (2) customs problems, and (3) the lack of cooperation from key Russian organizations. According to a Bechtel representative, nuclear liability concerns—and the resulting change in DOE's project management—contributed to an 8-month delay because additional contracts were not awarded to continue the work. As a result of these problems, the project has missed performance-related milestones. The project, which began in August 1993, was initially expected to be completed by December 1994. DOE now estimates that the project should be completed by November 1996. A Smolensk plant official told us that he appreciated the U.S. assistance but was disappointed that the fire safety equipment has not been delivered sooner. He said that the Russian bureaucracy has created many difficulties for the plant and the equipment is urgently needed.

With respect to customs problems, in October 1994, a shipment of fire safety equipment, including 100 fire suits and fire hose nozzles valued at about $110,000, was impounded by Russian customs officials pending payment of the applicable customs taxes. When the Smolensk plant refused to pay, the customs office brought the matter before a local court. The customs office noted that as a private enterprise, it was responsible for generating income. The court agreed and upheld the assessment. Because no duty was paid, the court subsequently declared the items abandoned and the property of the state. In January 1995, the court released the shipment to the fire department of a regional capital located approximately 100 miles from the nuclear power plant. After discovering that the fire suits had the name of the power plant's fire safety brigade labeled across the back in English, the city fire department notified the power plant. In September 1995, almost one year after the shipment had arrived at Smolensk, the equipment was sent to the nuclear power plant's fire brigade.

Because of the uncertainties associated with the customs clearance process, DOE decided to hold a $23,650 shipment of fire protection equipment destined for Smolensk in Helsinki, Finland. This equipment, primarily fire-retardant material, was stored at Helsinki in March 1995 and delivered to the plant in early January 1996. According to the Pacific Northwest National Laboratory, the shipper has reported storage costs of about $23,000, and the Laboratory is reviewing the reasonableness of this claim.

In another instance, approximately $5,000 in fire safety equipment—including one sample fire door—was lost on its way to the Smolensk nuclear power plant. Also included in the missing items were power transformers, cable wire, and a power distribution panel for a fire detection system. According to DOE, the items were fully insured and were replaced with no operational or financial impact on the project.

DOE and Pacific Northwest National Laboratory representatives and Bechtel officials also cited difficulty in working with Rosenergoatom to resolve difficulties in obtaining Russian certification for U.S.-supplied equipment. In April 1994, Rosenergoatom informed Bechtel that a considerable portion of U.S.-supplied equipment would have to be tested in Russia before it could be installed. The equipment identified for testing included fire brigade clothing, floor coating material, and fire doors. In April 1994, Rosenergoatom officials informed U.S. officials that none of the sample equipment previously left at the plant had been officially approved or certified because of the lack of funding. Rosenergoatom requested that the United States pay for the testing. Brookhaven National Laboratory agreed, but payment was delayed because of nuclear liability issues and the eventual change in DOE's program management.

The Pacific Northwest National Laboratory subsequently agreed to pay about $60,000 to Rosenergoatom for testing, but the contract was never signed because Rosenergoatom and the testing facility were unable to agree on how to share the anticipated U.S funds. During this period, Rosenergoatom refused to allow the U.S. contractor to visit the plant. In December 1995, after an absence of more than 2 years, Bechtel representatives were allowed to visit. According to DOE officials, Rosenergoatom and the plant are now accepting most of the materials without additional testing.

Both U.S. and Russian officials from the Smolensk nuclear power plant believed that the fire safety equipment will ultimately have a beneficial effect, even though only a portion of the fire safety equipment has been delivered or installed. A Smolensk plant official told us that the fire suits have already had an impact because the firefighters are less hesitant to perform their jobs because they have improved equipment. He also noted that the plant needs more U.S. equipment than is currently planned in order to make comprehensive safety improvements.

Spent-Fuel Storage for Zaporizhzhya Nuclear Power Plant

DOE is assisting Ukraine in developing on-site spent-fuel storage capacity at the Zaporizhzhya nuclear power plant in Ukraine so that the plant does not have to continue to pay for spent-fuel reprocessing in Russia.[6] According to DOE officials, without adequate spent-fuel storage capacity at Zaporizhzhya, Ukraine might be forced to shut down some of its plants and continue to operate Chornobyl to compensate for lost power production.

A key objective of the project is to transfer technology so that Ukraine can eventually manufacture the entire storage unit. This unit consists primarily of a concrete outer shell, a steel inner cask liner, and an inner basket, which holds the spent-fuel rods. For the DOE-funded portion of the project, U.S. vendors are supplying most of the metal materials and manufacturing major internal cask components for three storage cask (spent-fuel) systems. The components will be shipped to Ukraine for final assembly. Ukraine will be responsible for constructing the three concrete outer shells that will hold the spent fuel and will perform welding tasks. Ukraine is also providing certain materials and hardware. The goal is to provide Ukraine with the capability to manufacture the entire unit. DOE officials believe that once the technology is fully transferred, Ukraine will be able to manufacture about 12 casks per year in order to eventually allow the plant to become self-sufficient in managing spent fuel. Additionally, DOE officials believe that, if successful, Ukraine could export the casks.

While DOE officials noted that the project is not directly related to improving the safety of Soviet-designed reactors, it nonetheless is a high-priority program for Ukraine and the United States. DOE believes that the technology transfer element of this project is essential to the program's success. Additionally, the role of the Ukrainian regulatory body in monitoring the design and construction of the casks is central to DOE's emphasis on including the regulator in all aspects of nuclear safety. While these benefits may be achieved, Ukraine's limited resources raise questions about the number of casks it can ultimately manufacture. According to the contractor, hundreds of casks will be required to have a significant impact on improving capacity for on-site waste storage.

Project Costs

In December 1993, Ukraine's nuclear utility entered into an agreement with Duke Engineering and Services to supply Zaporizhzhya with 14 spent-fuel storage units valued at approximately $14 million. Subsequently, Ukraine requested that DOE help fund the project. DOE agreed to fund

[6]Zaporizhzhya operates six VVER Model 1000 reactors, the most modern Soviet-designed reactors.

$6.6 million of the total cost for the production of the first three casks. As of March 31, 1996, DOE had obligated $6.5 million and had spent about $5 million on the project. Table III.7 shows the expenditures in greater detail.

Table III.7: Expenditures for Zaporizhzhya Spent Fuel Storage Project, as of March 31, 1996

Expenditure	Amount
Labor	$171,478
Travel	16,144
Subcontracts/materials	4,386,079
Other indirect costs	87,915
Overhead	301,826
Total	**$4,963,442**

Sources: Brookhaven National Laboratory and PNNL.

Project Status

The overall pace of the project has been slow, although training has been provided to the Ukrainian regulator and plant staff and some equipment has been purchased and delivered. The project has faced significant impediments and is more than 6 months behind schedule; it was initially set for completion by the end of March 1996. DOE estimates that the project will now be completed after September 1996. At the time of our review, none of the casks had been built. The primary reasons for the delay are (1) a series of unanticipated design changes required by the Zaporizhzhya power plant and (2) greater-than-anticipated time to obtain a Ukrainian construction license. A U.S. contractor's representative told us that the plant's management has changed, causing interruptions in program continuity and responsibility for decision making. In his view, Ukraine's lack of experience in this type of technology—coupled with the desire to demonstrate independence—has contributed to difficulties with project implementation. For example, officials at a Ukraine design institute would not initially approve the use of a standard U.S. welding technique because they were unfamiliar with the process, delaying the manufacture of part of the cask for about 5 months.

Ukraine's nuclear regulatory body, which is responsible for approving the project design and construction, has been slow to issue a construction license. Pacific Northwest National Laboratory officials and a representative of Duke Engineering and Services noted that the regulator has failed to respond in a timely fashion to a safety analysis report that is needed before construction can begin. These officials noted, however, that the delay is somewhat understandable because this is the first time that the regulator has been requested to license such a system in Ukraine.

A Duke Engineering and Services representative said that customs problems did not delay project implementation. The project was already behind schedule because of problems with the Ukrainian regulator and plant management. However, he noted that several contractor personnel have spent time trying to resolve the customs issues, taking time away from other responsibilities. For example, some equipment including a $400,000 cask transporter, was impounded by Ukraine customs officials. The transporter and some ancillary equipment were delivered to the plant in early January 1996 but was not cleared for release to the plant until mid-April 1996.

Fire Safety Equipment for Zaporizhzhya Nuclear Power Plant

DOE is also providing fire safety equipment to the Zaporizhzhya nuclear power plant in Ukraine. DOE selected Zaporizhzhya—along with Smolensk—to be a pilot plant for the program to upgrade fire safety, expecting that this project would be implemented quickly. Burns and Roe is the primary U.S. contractor for the Zaporizhzhya project. DOE is purchasing fire protection suits, fire hose nozzles, smoke detectors, fire-proofing materials, fire alarms, and fire doors, and is assisting in installing the equipment. A key DOE objective is to transfer technology so that Ukraine can manufacture fire doors.

Project Costs

As of March 31, 1996, DOE had obligated $1.8 million and had spent about $1.7 million for the project. Table III.8 shows these expenditures in greater detail.

Table III.8: Expenditures for Zaporizhzhya Fire Safety Equipment, as of March 31, 1996

Expenditure	Amount
Labor	$25,682
Travel	3,337
Subcontracts/materials	1,610,871
Other direct costs	0
Overhead	32,681
Total	**$1,672,571**

Sources: Brookhaven and PNNL.

Project Status

The project did not meet its initial expected completion date of December 1994. DOE currently estimates that the project will be completed in December 1996. According to Burns and Roe, the U.S. contractor, the delays have been caused primarily by (1) the plant management's changes in work scope, (2) liability concerns, and (3) the inability of the Ukrainian company responsible for manufacturing the fire doors to meet milestones. Originally, Burns and Roe had planned to provide significant amounts of fireproofing materials for the reactor's walls. However, the plant's management subsequently requested that the materials be used for the floors, which required extensive reconfiguration of material requirements and rebidding of contracts. DOE's project manager estimated that nuclear liability problems—and the resulting change in project management from Brookhaven to DOE—created a delay of 1 year.

A Burns and Roe representative said the acquisition of Ukrainian-manufactured fire doors has delayed the project by about 7 months. As part of its program to transfer technology to support recipient countries' infrastructure, DOE identified a Ukrainian company to produce fire doors for Zaporizhzhya. This company is expected to manufacture 122 fire doors that will be installed at one unit of the plant. Initial efforts to produce the doors were delayed because prototype doors manufactured by the company failed certifications tests. According to the U.S. contractor, the Ukrainian company then took about 5 months to redesign the doors. The doors passed inspection in June 1995. This company will be paid about $70,000 to produce the doors. At the time of our review, the production of the doors had recently begun. DOE estimates that all of the doors will be installed by September 1996.

Overall, the project now appears to be progressing more smoothly. According to a Burns and Roe representative, the project is approximately 90-percent complete. According to DOE officials, with the exception of the Ukrainian fire doors, most of the equipment has been delivered, including 50 fire suits, 1,242 sprinkler heads, 160 smoke detectors, and fireproof sealant material. Other equipment, including fire extinguishers and face masks, will be provided by Ukrainian vendors.

DOE and Pacific Northwest National Laboratory officials, as well as a Burns and Roe representative, believe that the project has met most of its safety-related objectives. In their view, the one operating unit at Zaporizhzhya that is receiving fire safety equipment is now more capable of reducing the incidence of fire and has an increased capacity to mitigate a fire's consequences. DOE officials are confident that the Ukrainian company will continue to manufacture fire doors for Soviet-designed reactors, at least in the near-term. For example, the Ukrainian company was negotiating a contract with the Laboratory to provide between 300 and 500 fire doors for Chornobyl. In addition, these officials believe that the company will provide more doors to Zaporizhzhya over the next few years. They expressed some concern, however, about whether funds would be sufficient to provide fire safety upgrades at more than one unit of the plant.

Emergency Operating Instructions for Soviet-Designed Reactors

DOE is assisting plant operators in developing symptom-based emergency operating instructions for Soviet-designed reactors. In the event of an emergency, symptom-based operating instructions are designed to (1) specify operator actions in response to changing plant conditions, (2) allow the operator to stabilize the reactor without having to first determine the cause for the changing reactor conditions, and (3) contribute to faster decision making.[7] DOE and national laboratory officials believe that the development and implementation of these instructions is one of the more significant components of the U.S. program to provide nuclear safety assistance. In their view, these instructions focus on the human element of safety and will contribute to a self-sustaining safety culture. DOE is also assisting in the development of operator training for the instructions. In addition, DOE is assisting in the development of operational control procedures.

The Institute of Nuclear Power Operations (INPO) has been responsible for transferring the U.S. methodology for developing and implementing the symptom-based emergency operating instructions. INPO was established by the U.S. nuclear industry in 1979 following the Three Mile Island Accident. Its purpose was to enhance the safety and reliability of commercial nuclear power plants. INPO has developed a series of operational procedures and guidelines that have been adopted by power plant operators throughout the United States and is considered a leader in the field of operational safety in general and in the field of symptom-based emergency operating instructions in particular.

[7]There are two general types of emergency operating instructions: event-based and symptom-based. Event-based instructions require the operators to first identify the cause of the problem and then follow the specified actions for that event. This type of procedure was used at U.S. nuclear plants prior to the Three Mile Island Accident in 1979 and is currently used at most Soviet-designed nuclear power plants. The symptom-based approach is currently used at all U.S. and many other western nuclear power plants.

Project Costs

Since February 1991, DOE has awarded four sole-source contracts to INPO for $13.5 million to transfer documents and expertise to help develop emergency operating instructions for the Newly Independent States.[8] The contract prices were based on a fee system used for membership in INPO. Under the terms of these fixed-price contracts, DOE accepted the fact that INPO's accounting system did not meet government cost accounting standards and did not break out costs by such categories as labor, travel, and overhead.

In addition to the INPO contracts, DOE has spent about $1.8 million to support the development of the instructions. (See table III.9.)

Table III.9: Expenditures for the Development of Emergency Operating Instructions, as of March 31, 1996

Expenditure	Amount
Labor	$181,211
Travel	394,454
Subcontracts/materials	822,464
Other indirect costs	49,802
Overhead	389,528
Total	**$1,837,459**

Sources: Brookhaven National Laboratory and PNNL.

As part of its overall support for the project, DOE is providing funds directly to several Russian nuclear power plants. As of March 1996, the Pacific Northwest National Laboratory had awarded contracts totaling $1.1 million to nine nuclear power plants that are developing the instructions in Russia, Ukraine, Bulgaria, and Lithuania. DOE's project manager said the funds are needed to accelerate the pace of the program.

Project Status

The development and implementation of the emergency operating instructions has faced considerable impediments and delays. The experience at the Novovoronezh nuclear power plant is a case in point. In 1992, DOE's former Assistant Secretary for Nuclear Energy said in congressional testimony that by mid-1993, 35 emergency operating instructions were to be implemented at Novovoronezh.[9] By March 1996, only 22 of the instructions had been approved for implementation at one

[8]Of the $13.5 million contract, $6.5 million has been funded under the 1992 Lisbon Initiative. The balance of $7 million predates the Initiative and was funded through other DOE programs.

[9]Safety of Soviet-Designed Nuclear Power Plants, statement before the Senate Committee on Energy and Natural Resources (June 16, 1992), p. 41.

of the plant's operating units. DOE and INPO officials noted that while the plant had drafted all of the procedures in 1992, numerous factors had delayed approval and implementation. Russian organizations that are responsible for approving the procedures have been slow to act and have not given the project priority status.

A Pacific Northwest National Laboratory official told us that the Russian regulator and the VVER design institute were not included in the early part of the project. While this approach was dictated by the Ministry of Energy in the former Soviet Union, it became increasingly apparent that this approach did not ensure adequate coordination. A DOE official said that it was difficult to obtain a consistent story about which Russian organization was responsible for the delays. In August 1995, a Rosenergoatom official told a DOE official that the emergency operating instructions, in general, had been "headaches and a drain on resources." In a March 1995 meeting between DOE and Minatom officials, DOE noted that it was very difficult to defend the U.S. nuclear safety assistance program when the Novovoronezh instructions were taking so long to be approved. DOE officials responsible for the project noted that although coordination among the key Russian organizations has improved over the years, it still could be better.

DOE and Pacific Northwest National Laboratory officials noted that Russian officials have grown more supportive of the project. For example, the same Rosenergoatom official who had earlier criticized the project has made supportive statements since that time, according to DOE. In addition, in late September 1995, senior managers of key Russian organizations told a DOE representative that the project was a priority and that project management would be improved. Although disappointed by the pace of the instructions' development, U.S. officials believe that progress is being made because Russia and Ukraine are displaying a greater commitment to implementing the instructions. For example, Goscomatom decreed that all reactor sites must develop emergency operating instructions by December 1996. In January 1996, Rosenergoatom directed all Russian plants to implement the instructions.

Nevertheless, impediments remain for the project. For example, according to INPO, the development of the VVER instructions had stalled because the design institute had not provided engineering analysis. Furthermore, the design institute was generally unwilling to perform the analysis without compensation, which the nuclear power plants are unable to provide without funding assistance from the United States. Table III.10 shows the status of the emergency operating instructions by reactor type as of March 1996.

Table III.10: Status of Emergency Operating Instructions, as of March 1996

Reactor type/activity	Novovoronezh/ VVER 440/230[a]	VVER 440/213	VVER 1000	RBMK
Percent of instructions drafted	100%	About 70%	100%	About 85%
Planned drafting completed (Month/year)	Complete	3/1997	Complete	10/1996
Status of analysis by design institute	Working on last 10 instructions	[b]	Recently begun	Being provided
Status of regulatory approval	Partial approval	[c]	[c]	[c]
Planned implementation date (Month/year)	Partial approval on 3/1996. Additional 10 planned for 6/1997	3/1998	12/1998	9/1997

[a]Novovoronezh is the key pilot plant.

[b]The needed analysis has been identified. However the performing organization has not received any funds to perform the necessary analysis.

[c]Awaiting receipt of final documents from the nuclear power plants.

Source: INPO and DOE.

U.S. officials cited a case in which operators' exposure to the process of developing the instructions provided them with the knowledge to respond more effectively and efficiently to emergency conditions. In response to leakage of cooling water from a Ukrainian reactor, operators took specific actions to control the water leakage and prevented the reactors from overheating.

Joint Parallel Nuclear Alternatives Study for Russia

In December 1993, the U.S. Secretary of Energy and the Russian Minister of Fuels and Energy agreed to conduct a joint study to examine options for electric power in Russia, as recommended by the Gore-Chernomyrdin Commission.[10] This study was (1) intended to build on a 1993 study on

[10]The Commission was created in 1993 to overcome trade barriers in the energy sector but has expanded into other areas, including business development, space, and science and technology.

electricity options for Russia prepared for the G-7 by the World Bank, the International Energy Agency, and the Russian government and (2) expected to provide a framework for investment by international financial institutions in Russia's electricity sector.

U.S.-Russian working groups were established on energy efficiency, thermal power plants, nuclear power, hydroelectric power, and a joint steering committee with representation from the Department of State, USAID, DOE and NRC. Because of Minatom's initial resistance to participating in the joint study, DOE agreed to produce a second, parallel study that focused exclusively on the nuclear sector in Russia. DOE expected that its study would provide Russia with a cost-based analysis of nuclear energy options. The options evaluated were (1) enhancing the safety of operating plants, (2) closure and decommissioning of operating plants, (3) conversion of a partially built power plant to gas or coal, (4) completing a partially built plant, and (5) building a new generation of plants. The conclusions and findings of the nuclear study were integrated into the broader study.

Project Costs

DOE spent about $2 million to prepare the Joint Parallel Nuclear Alternatives Study for Russia. The study was funded under DOE's international nuclear safety program. (See table III.11 for greater detail.) The broader study, the Joint Electric Power Alternatives Study, prepared by USAID and its contractors, cost about $8 million.

Table III.11: Expenditures for the Joint Parallel Nuclear Alternatives Study for Russia, as of March 31, 1996

Expenditure	Amount
Labor	$143,953
Travel	148,373
Subcontracts/materials	1,308,394
Overhead	409,525
Total	**$2,010,245**

Source: Brookhaven National Laboratory.

Project Status

DOE's nuclear study was completed in May 1995 and the broader electric power study was presented at a meeting of the Gore-Chernomyrdin Commission in June 1995. Both studies were intended to be completed on a fast track in order to be available for the July 1994 G-7 meeting, but completion of the studies was delayed for about 1 year. This delay increased DOE's project costs by about $1 million. Department of State and Brookhaven officials told us that project delays were due to Russian difficulties in developing the data and models, and disagreements over cost assumptions. In addition, a large number of Russian energy ministries, institutes, and organizations jointly prepared the report with the United States, and it took more time than anticipated to get their agreement on the report.

Although there were initial difficulties in gaining the cooperation of Minatom, a Department of State official believes that one of the long-term benefits of the DOE-funded study is that Minatom worked cooperatively with other Russian energy ministries and organizations. The study found that nuclear power was cost- competitive with other sources of electricity in Russia and concluded that it was in Russia's economic interest to upgrade some plants and to close four to six of its older plants. The study also recommended that Russia develop a decommissioning program for a specific RBMK type of reactor. DOE and Brookhaven are now working with Minatom, the Kurchatov Institute in Moscow, and the Leningrad nuclear power plant in Russia to initiate a decommissioning study for Unit 1 of the plant.

Nuclear Regulatory Commission Safety Assistance Projects

This appendix discusses four nuclear safety projects that NRC is implementing in Russia and Ukraine. These projects, with a total value of about $10.5 million, focus on (1) providing analytical simulators for Russia and Ukraine, (2) developing an emergency response center in Russia, (3) helping develop legal authority for Russia's nuclear regulatory body, and (4) supporting efforts to perform a probalistic risk assessment at a Russian nuclear power plant.

Analytical Simulators for Russia and Ukraine

NRC plans to provide four analytical simulators for the nuclear regulatory bodies in Russia and Ukraine to use for training purposes.[1] Simulators are planned for Ukraine's regulatory center in Kiev and Russian regional and headquarters' sites. The regulators will receive software needed to model VVER-1000 plants at Zaporizhzhya in Ukraine and Balakovo in Russia, a VVER-440/213 plant at Rivne in Ukraine, and an RBMK plant at Kursk in Russia. In addition, the regulators will be trained to perform software modifications so that nuclear power plants at Chornobyl and Kola can also be simulated.

The analytical simulators will enable the regulators to familiarize themselves with plant operations. NRC believes that the regulators' ability to monitor plant safety will be improved significantly by providing dedicated training simulators. Currently, only a handful of regulators obtain a few hours of training on existing plant simulators in Russia and Ukraine. When fully implemented, the regulators are expected to have an integrated system of computer hardware and software and to train designated personnel in the use and maintenance of the analytical simulators.

Project Costs

NRC has allocated about $1.5 million for Russia and $2 million for Ukraine. As of March 31, 1996, NRC had obligated and expended $12,839 of this amount on personnel travel but had not yet spent any of its funds for Ukraine. Equipment and other deliverables have not yet been provided to Russia and Ukraine because of procurement problems at NRC. Table IV.1 shows the expenditures for this project in greater detail.

[1]NRC has five full-scope simulators at a training center in Chattanooga, Tennessee. Analytical simulators run the same software as the full-scope simulators, but control room and panels are not provided. The simulation is displayed on computer monitors.

Table IV.1: Expenditures for Analytical Simulators, as of March 31, 1996

Expenditure	Amount
Contractor personnel	$0
Travel	12,839
Training	0
Equipment	0
Total	**$12,839**

Source: NRC.

Project Status

The analytical simulator project was originally planned for completion by December 1996. NRC now projects that it will be completed about mid-1999. Project implementation has been slow primarily because of procurement delays. NRC has twice requested proposals for the analytical simulators in an attempt to obtain what it views as a reasonable price for the work envisioned. In May 1995, NRC requested proposals for simulators to be supplied to Russia. NRC considered the one proposal it received to be unreasonably high when compared with the government's estimate of about $3 million. In December 1995, NRC solicited a proposal for both Russia and Ukraine and awarded a contract in June 1996 for $2.6 million.

NRC plans to complete the project in several phases. The first phase, which started in December 1993 and is to be completed around December 1997, involves training personnel and delivery of simulator hardware to Russia and Ukraine. The second phase, which is projected to start in January 1997 and end in August 1998, involves the delivery of additional hardware to Russia. The third phase, which NRC plans to begin in September 1997 and complete by mid-1999, focuses on additional training and improved capabilities for the simulators.

Emergency Incident Response Support Center in Russia

NRC is assisting Russia's regulatory organization, Gosatomnadzor (GAN), in establishing a basic communications system and essential support capabilities for responding to emergencies at nuclear power plants.[2] NRC's effort is intended to reduce the severity of an emergency, should one occur, by reducing the incidence of radiological exposure to the public and the environment. The project provides for the purchase, installation,

[2]The Russian system is essentially modeled on the U.S. emergency response approach. The U.S. system is a "real-time" program to provide direct transmission of selected nuclear power plant information from the licensee's on-site computers to NRC's Operations Center in Rockville, Maryland. The Operations Center coordinates and disseminates information about the emergency to various U.S. and international organizations.

and in-place testing of prototype equipment at three locations—GAN Headquarters in Moscow, the Leningrad nuclear power plant near St. Petersburg, and the Kalinin nuclear power plant located between these two cities. After the prototype phase is completed, NRC plans to provide equipment to 11 other nuclear power plants and regional regulatory offices in Russia. Figure IV.1 shows the emergency response center in Moscow.

Figure IV.1: Emergency Incident Response Center at GAN Headquarters, Moscow, Russia

Source: Science Applications International Corporation.

NRC plans to complete a fully functional emergency support center in Moscow with communication links to each Russian nuclear power plant. NRC is taking a phased approach because of, among other things, operating uncertainties in Russia. NRC has contracted with Science Applications International Corporation (SAIC) for almost all of the work on the project, in accordance with plans approved by both NRC and GAN. NRC expects that a minimum amount of assembled equipment will be tested and operated in Russia during the prototype phase. The purpose is to determine if the equipment is fully suitable before making a U.S. investment in the entire Russian response system.

NRC officials believe that once the transmission links are fully functional, the project will begin to show tangible, measurable progress. By improving communications among the plants and GAN, NRC believe the regulatory body's role will be enhanced significantly because it will play a major role in coordinating activities in case of a nuclear power plant emergency.

Project Costs

NRC has budgeted $1.5 million for the project. As of March 31, 1996, NRC had obligated about $1.3 million and had spent $524,738 for the project. Table IV.2 shows how the funds have been spent.

Table IV.2: Expenditures for Emergency Incident Response Center, as of March 31, 1996

Expenditure	Amount
Contractor Personnel	$313,521
Travel	60,857
Training	0
Equipment	150,360
Total	**$524,738**

Source: NRC.

Project Status

The project, started in October 1992, was originally expected to be completed by February 1996 but is now projected to be completed by September 1997. NRC has provided some prototype equipment but has not yet expanded the project to provide basic communications and support equipment to all of the Russian nuclear power plants and to GAN headquarters. The prototype equipment associated with the project includes three compatible computers with fax modems and software, a dot-matrix printer, a facsimile machine, and three high-frequency radio base stations with fax modems.

NRC officials and SAIC representatives said the prototype communications system, which is partially functioning, faced several impediments that delayed operations. For example, permits obtained from Russia's Ministry of Communications to test radio communications were temporary and good for initial tests only. Under the prototype phase, the initial results from testing were poor but because the temporary permits had expired, further testing had to await better, permanent frequency assignments and permits by the Ministry. NRC finished the prototype work in the spring of 1996, and not by January 1995, as originally estimated.

In addition, project-related equipment has not always been delivered in a timely manner because of customs problems. For example, three antennas costing about $2,000 were held by Russian customs for several weeks in mid-1995. The U.S. contractor had shipped the antennas, but they were impounded by customs officials, who demanded payment of import duties to release them. NRC brought this matter to the attention of a GAN official to get the equipment released. In another case, 10 modems and related cables that GAN officials had hand-carried to Russia were impounded by customs officials. As a result of that customs action, other shipments were halted and the installation of the equipment was put on hold. The matter was resolved in September 1995, but a SAIC representative told us that he has spent large amounts of time assisting GAN with customs problems.

Nuclear Legislation and Licensing Initiatives in Russia

NRC is helping GAN to (1) develop a legal framework and create a system of enforcement and economic sanctions and (2) improve its ability to license civilian nuclear power plants and other civilian nuclear installations. NRC and GAN consider these objectives to be among the highest priority. Without a legal foundation for its operations—and the ability to impose fines for improper operations—GAN's long-term effectiveness and viability remain questionable. GAN's First Deputy Chairman told us that without the appropriate legislative backing, his organization will not be able to function effectively within the Russian nuclear bureaucracy. For example, the Russian official noted that although GAN can impose fines on nuclear installations, the fines are of little value.

In the fall of 1994, NRC officials provided comments to GAN on the draft Russian law pertaining to the use of nuclear energy. The comments primarily related to the need to clarify GAN's regulatory independence. According to NRC officials, NRC is not attempting to impose its own regulatory system on GAN. Rather, it seeks to work collaboratively and tailor its support to meet the needs of GAN. As a result, GAN has acquired detailed information about NRC regulatory practices and legal responsibilities through this project.

Project Costs

NRC had allocated $577,934 for the project as follows: $502,934 for licensing activities and $75,000 for legislative and enforcement initiatives. As of March 31, 1996, NRC had obligated $479,773 and had expended $328,638 for licensing activities, and had obligated and spent $39,010 for legislative initiatives. Table IV.3 shows these expenditures in greater detail.

Table IV.3: Expenditures for Licensing and Legislative Initiatives, as of March 31, 1996

Expenditure	Amount
Licensing activities	
Contractor personnel	$152,309
Travel	176,329
Training	0
Equipment	0
Subtotal	**$328,638**
Legislative initiatives	
Contractor personnel	$0
Travel	39,010
Training	0
Equipment	0
Subtotal	**$39,010**
Total	**$367,648**

Source: NRC.

Project Status

Both the legislative and licensing initiatives have been delayed. The licensing project was originally scheduled to be completed in mid-1995 and is now scheduled for completion in mid-1997. The legislative initiative, which began in May 1994, was originally expected to be completed by December 1995. NRC now anticipates that the initiative will conclude by December 1996. NRC officials cited a number of factors that have contributed to schedule slippages, including (1) changes in the scope of the project, (2) longer-than-anticipated time to prepare and translate critical documents, and (3) delays in Russian completion of legislation and drafting of an enforcement policy. NRC officials emphasized that the completion of the project depends to a great degree on the maturation of GAN and its acceptance within the Russian bureaucracy.

Despite these delays, NRC officials view the progress made under these initiatives as an important first step toward increased regulatory independence and effectiveness. In November 1995, Russian President Yeltsin signed legislation that established, in part, a legal framework for the regulation of nuclear safety.[3] NRC assisted GAN in drafting this legislation. Both NRC and GAN officials noted that the law is a significant step toward "legitimizing" GAN. GAN has also been designated as the lead

[3]The law entitled "Russian Federation Law on the Use of Atomic Energy" was passed by the Russian Parliament in Oct. 1995.

agency to develop a supplemental law about the roles and responsibilities of the regulatory organization in Russia. NRC officials also believe that the licensing initiative is now moving ahead. For example, GAN submitted a document to NRC that addresses the process for submitting and approving licenses for various nuclear installations.

Probalistic Risk Assessment for Kalinin Nuclear Power Plant

NRC is supporting Russia's efforts to involve six Russian organizations, including GAN, to perform a Probalistic Risk Assessment for a VVER-1000 reactor at unit 1 of the Kalinin nuclear power plant. A Probalistic Risk Assessment is used to evaluate the potential for significant accidents occurring at a plant during different power operations. NRC has entered into agreements with six Russian organizations, including the plant designer, plant operator, the utility, and the regulator, to facilitate the assessment. GAN is responsible for coordinating and managing the project with the various Russian organizations participating in the development of the risk assessment.

NRC believes that by performing the risk assessment, GAN and the other Russian participants will (1) obtain Probalistic Risk Assessment training and develop expertise to perform and/or evaluate risk assessments conducted for other nuclear power plants, (2) achieve an improved understanding of the value of risk assessments and their uses for improving safety, and (3) increase its stature. Additionally, NRC anticipates that as the Russian organizations collaborate on the project, they will become more open and willing to cooperate among themselves in conducting risk assessments on other plants in Russia.

Project Costs

NRC plans to spend $2.5 million for the project. As of March 31, 1996, NRC had obligated $1.4 million and had spent about $1.1 million. Table IV.4 provides detailed information on these expenditures.

Table IV.4: Expenditures for Probalistic Risk Assessment for Kalinin Nuclear Power Plant, as of March 31, 1996

Expenditure	Amount
Contractor personnel	$974,635
Travel	89,437
Training	0
Equipment	0
Total	**$1,064,072**

Source: NRC.

Project Status

The project began in mid-1994 but initially experienced difficulty getting under way. According to NRC officials, a number of factors contributed to delays. NRC had some difficulty obtaining agreement among the various Russian participants about their respective roles, responsibilities, and the extent to which a final report would be distributed to other VVER-1000 plants. NRC and GAN signed a memorandum of understanding for the project in December 1994, but the final implementing agreements for all the other Russian participants were not approved until August 1995. Development of the project guidelines was also delayed.

To date, the project has focused primarily on defining the scope of the project, developing specific procedure guides for each project task, and formalizing the amount and type of training needed. In March 1996, NRC held a 2-month risk assessment workshop at which Russian technical staff representing the participating organizations met with NRC and U.S. experts. The purpose of the workshop was to begin the practical integration of the organizations and to focus on specific probalistic risk assessment tasks. NRC is attempting to structure the training so that the Russian organizations will be able to perform the probalistic risk assessments on their own with periodic NRC assistance and oversight. As part of this process, the Kalinin nuclear power plant staff is expected to provide specific information on plant design, operating history, and operating procedures.

Scope and Methodology

To identify the goals and objectives of the U.S. nuclear safety assistance program, we interviewed and obtained pertinent documents from officials at the Department of State, USAID, DOE, and NRC. We also met with officials at the Brookhaven National Laboratory in Upton, New York, and at the Pacific Northwest National Laboratory in Richland, Washington. We also met with representatives of the Nuclear Energy Institute and the Natural Resources Defense Council in Washington, D.C., to obtain their views about the priorities, objectives, and implementation of the U.S. program.

To provide information on the amount and type of U.S. assistance being planned or provided, we obtained cost and program funding data from U.S. government agencies that provided the assistance. Specifically, we obtained these data from DOE, the Brookhaven and Pacific Northwest National Laboratories, and NRC. We did not independently verify the accuracy of the data they provided.

To determine how the U.S. safety assistance program was being implemented, we judgmentally selected 13 DOE and NRC safety projects to review. These projects are valued at about $67 million. We limited our selection of projects to Russia and Ukraine because those countries are the primary recipients of U.S. assistance to improve the safety of Soviet-designed reactors. We based our selection on a number of factors: (1) the maturity of the project; (2) dollar value; and (3) diversity—equipment-related projects, training-related projects, legislative initiatives, and a study of nuclear energy options for Russia. We discussed our selection of projects with DOE and NRC officials. DOE officials requested that we add some additional training and equipment projects to our sample, which we did. NRC officials said the projects we chose represented a fair sample of the type of assistance NRC is providing.

To assess the status of the selected projects and how they are improving safety, we met with appropriate DOE, NRC, and national laboratory officials. We also met with U.S. contractor representatives responsible for implementing the projects for DOE and NRC. Specifically, we met with officials from the following U.S. firms: Burns and Roe Company (Oradell, New Jersey); Science Applications International Corporation (Germantown, Maryland); S-3 Technologies, Inc. (Columbia, Maryland); Duke Engineering and Services (Charlotte, North Carolina); Sonalysts, Inc. (Waterford, Connecticut); and Bechtel Power Corporation (Gaithersburg, Maryland). We also met with a representative of the Institute of Nuclear Power Operations (Atlanta, Georgia).

We met with officials from Russia and Ukraine to obtain their views on U.S. nuclear safety assistance. Specifically, we met with Russian representatives from the Smolensk nuclear power plant and Russia's Ministry of Atomic Energy, Minatom. We also observed a week-long safety assistance planning meeting between NRC and GAN officials. We met with several GAN officials, including the First Deputy Chairman, to discuss their views about the U.S. assistance program. We discussed the implementation of the Khmelnytskyy simulator project with several Ukrainian representatives from the plant and from Ukraine's nuclear utility, Goscomatom. These representatives were part of the technology transfer team temporarily residing in the United States.

Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

Department of Energy
Washington, DC 20585
September 17, 1996

Mr. Victor S. Rezendes
Director, Energy, Resources, and Science Issues
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Rezendes:

Thank you for the opportunity to provide comments on the General Accounting Office report, "Nuclear Safety: Status of the U.S. Assistance to Improve the Safety of Soviet-Designed Reactors," RCED-96-235. I understand that members of my staff have already resolved many technical questions in cooperation with your staff. On the whole we agree with the findings in the report. There remains, however, a significant point that needs further clarification.

See comment 1.

The report states that, in the view of the General Accounting Office, our assistance program poses a dilemma because it may encourage the continued operation of the same reactors that the United States wants to see closed as soon as possible. I strongly disagree that the program poses such a dilemma. First, I stress that the Department of Energy fully supports the goal of shutting down the riskiest reactors as soon as possible. However, the closure of a single reactor has been estimated to cost roughly $1 billion to provide replacement power and to address socioeconomic impacts. There is therefore strong opposition within the host countries to early closure of operating reactors. Thus, although we firmly urge shutdown, the economic circumstances of the host countries interfere with achieving our objectives.

See comment 1.

Much of the Department's program is intended to improve the safety culture within which the plants operate through training, improved emergency procedures, safety analysis, and regulatory oversight. Equipment is being provided to address specific safety deficiencies or to prevent the failure of critical safety equipment at nuclear power plants. This equipment does not affect the life-limiting components of these plants and its value is very small compared to one billion dollars. In our view, the choice is whether these plants will operate with or without important improvements to safety systems. Because the improvements do not themselves affect the life-limiting components, we believe it would be irresponsible not to improve safety.

Moreover, our work to improve safety analyses and regulatory oversight will serve to enhance the awareness of safety deficiencies by organizations within the host countries. This awareness will encourage these countries to make sound decisions regarding early closure.

2

The real force preventing early closure of reactors is the severe economic conditions in these countries. The U.S. Government is providing assistance to these countries to encourage economic reforms and strengthen the energy sector. The safety improvements we sponsor are an integral part of a broad U.S. Government program that addresses these adverse economic conditions.

Sincerely,

Terry R. Lash, Director
Office of Nuclear Energy,
Science and Technology

The following are GAO's comments on DOE's letter dated September 17, 1996.

GAO's Comments

1. DOE disagreed with our position that the U.S. safety assistance program poses a dilemma because it may encourage the continued operation of the same reactors that the United States wants to see closed as soon as possible. DOE said that the equipment it is providing is targeted to specific safety deficiencies or to prevent the failure of critical safety equipment and does not extend the operating life of the Soviet-designed nuclear power plants. We have not asserted that the equipment will extend the life of the Soviet-designed plants but believe that some of this equipment may be used to justify the continued operation of the plants. As we noted in the report, the repair or replacement of any component that the plant relies on would support continued plant operations. In our view, DOE's RBMK maintenance initiative provides the equipment, training, and transfer of technology that enables plant components to remain in service longer—thereby supporting continued plant operations while improving plant safety.

For this reason, we maintain that the U.S. program poses a dilemma for U.S. policymakers. While the United States remains committed to the goal of shutting down the highest-risk plants, the assistance has the potential to keep the plants operating longer than they otherwise might have.

Comments From USAID

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

USAID

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Assistant Administrator
Bureau for Europe and the New Independent States

SEP 18 1996

Mr. Victor S. Rezendes
Director, Energy, Resources, and Science Issues
General Accounting Office
Washington, D.C. 20548

Dear Mr. Rezendes:

See comment 1.

See comment 2.

The Agency for International Development appreciates the opportunity to comment on the GAO Draft Report on Nuclear Safety: Status of U.S. Assistance to Improve the Safety of Soviet-Designed Reactors. Some of our staff comments have been already been included. We still consider that the report understates the progress that the U.S. has made in introducing for the first time US experts and technologies into these Soviet-designed reactors. In addition, we feel that the report makes generalizations about the issue of reactor closure that need to be analyzed in a broader economic and energy context. We hope that the reader does not come away with the impression that no progress is being made on this issue. We accordingly submit for the formal report annex, the following statement summarizing the situation in key countries.

Ukraine: The U.S. has played a key role in the unique G-7/Ukraine Memorandum of Understanding (MOU) on the Closure of Chernobyl by the Year 2000 and in the development of a $3 billion financing package to support nuclear safety, decommissioning and energy sector reforms. Unit 1 is currently expected to be closed by the end of 1996, ahead of the MOU schedule.

Russia: We consider the Russian willingness to begin decommissioning preparations at the Leningrad RBMK as a significant accomplishment that was furthered by the Joint Electric Power Alternatives Study and the Joint Parallel Nuclear Study. Progress has also been made increasing the role of the regulator(GAN) in the performance of internationally-acceptable safety analyses.

Armenia: The Armenian Government has stated numerous times its intention to close the Medzamor Nuclear Power Plant as soon as practical and is working with the World Bank and EBRD on a least-

- 2 -

cost investment program to achieve this as well as undertaking price and other reforms to improve the potential for financing alternatives. A closure date of the year 2004 is part of the conditionality for the EBRD Hrazdan loan rescheduling agreement.

Lithuania: The Lithuanians are cooperating with the Nuclear Safety Acount, the United States and other countries in the safety assessment of Ignalina, in the development of a least-cost plan that is examining options to Ignalina, in the development of a nuclear regulatory agency and in regional energy planning and power pooling activities that are essential for attracting major new power investments and respond to the specific request from the Baltic Energy Council for US assistance in examining long-term options for the replacement of Ignalina.

Bulgaria: The Bulgarians have increased energy prices and are working with the IMF, the World Bank, the United States and other other countries to improve the financial position of the power industry and implement projects to improve nuclear safety and develop alternatives to Kozluduy.

Slovakia: The Slovaks have continued to involve Western companies and technology in the completion of the Mochovce Nuclear Power plant that could provide the basis for the closure of the Bohunice I plant at the end of its service life if not sooner.

In sum, US nuclear safety programs are operating in this broader energy context and are helping to create an environment of engagement and dialogue on both the specific issues of nuclear plant management and safety and the critical linkage between power sector reform and nuclear safety investments and plant closures.

Sincerely,

Donald Pressley
Deputy Assistant Administrator
Bureau for Europe and the
New Independent States

GAO's Comments

The following are GAO's comments on USAID's letter dated September 18, 1996.

1. Regarding USAID's comment that progress has been made in the U.S. assistance program, our report noted that several projects we reviewed are progressing and have, for example, resulted in installing fire safety equipment and other safety-related hardware. However, it is too early to assess the progress these projects have made in safety because only one of the projects we reviewed had been completed. Furthermore, most of the 13 projects we reviewed had been delayed, and progress was slow in many cases.

2. USAID commented that the report gives the impression that no progress is being made toward obtaining the closure of the highest-risk Soviet-designed reactors. Our report cites several instances in which closure commitments have been made but also notes that it will be difficult for the countries to meet specific closure dates because of the slow pace of economic reform and the need for financing to help develop alternative energy sources. We also note, however, that to date no reactors have been closed, and one was recently restarted.

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.

Bernice Steinhardt, Associate Director, Energy, Resources, and Science Issues
Gene Aloise, Assistant Director
Glen Levis, Evalutor-in-Charge
Sarah E. Veale, Senior Evaluator
Philip A. Olson, Senior Evaluator
Duane G. Fitzgerald, Ph.D., Nuclear Engineer

Office of General Counsel

Jackie A. Goff, Senior Attorney

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000
or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

PRINTED ON RECYCLED PAPER

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested