United States General Accounting Office

GAO

Report to the Honorable
Bob Graham, U.S. Senate

November 1995

NUCLEAR SAFETY

Concerns With Nuclear Facilities and Other Sources of Radiation in the Former Soviet Union

GAO/RCED-96-4

GAO

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

Resources, Community, and
Economic Development Division

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November 7, 1995

The Honorable Bob Graham
United States Senate

Dear Senator Graham:

While the safety problems of the 58 Soviet-designed civil nuclear power reactors operating in the former Soviet Union and central and eastern Europe have received considerable international attention and assistance, many other nuclear facilities and other sources of radiation in the former Soviet Union also pose safety, health, and environmental concerns. For example, a 1993 accident at a plutonium reprocessing plant in Russia underscored the safety problems associated with these types of facilities.

This report responds to your request that we provide information on (1) nuclear facilities (other than civil nuclear power reactors), nuclear-powered vessels, and other sources of radiation in the former Soviet Union; (2) the views of U.S. and international experts on the safety of these facilities and other sources of radiation; and (3) U.S. and international efforts to address nuclear safety and environmental problems associated with these facilities and other sources of radiation. A forthcoming GAO report will address U.S. assistance to improve methods of safeguarding nuclear material at facilities in the former Soviet Union.

Results in Brief

According to available information, the countries of the former Soviet Union[1] have at least 221 operating nuclear facilities, not including civil nuclear power reactors. Ninety-nine of these facilities are located in Russia and include facilities involved in plutonium production and processing as well as weapons design and production. Russia also has a fleet of nuclear-powered vessels, including 228 submarines. In addition, according to the Department of Defense (D0D), as many as 10,000 to 20,000 organizations throughout the former Soviet Union may be using different types of radiation sources for medicine, industry, and research.

Nuclear safety experts, including Russian officials, are concerned about the safety of certain nuclear facilities and the potential for accidents, particularly at facilities for producing or reprocessing plutonium and at some sites for decommissioning nuclear submarines. The following five

[1]For purposes of this report, the countries making up the former Soviet Union are Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgystan, Latvia, Lithuania, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

major factors contribute to unsafe conditions in the former Soviet Union: (1) aging facilities and equipment and inadequate technology; (2) the lack of awareness of and commitment to the importance of safety; (3) the long-standing emphasis on production over safety; (4) the absence of independent and effective nuclear regulatory bodies; and (5) the lack of funds for safety improvements. To better understand the overall safety conditions, Department of Energy (DOE) officials said they need increased access to Russian facilities.

Nuclear safety experts cited the radiological contamination generated by past and continued operation of nuclear weapons operations in the former Soviet Union as a current safety and environmental concern. For example, over many years, nuclear waste from three large sites in Russia that produced plutonium had been discharged directly into surrounding lakes and rivers. Currently, radioactive waste is being injected into the ground and continues to be stored improperly. In addition, Russia's history of dumping liquid and solid radioactive waste from nuclear-powered submarines and icebreakers into the Arctic seas[2] and the Sea of Japan has raised concerns about the long-term environmental effects of this practice.

Although most U.S. and international assistance is aimed at improving the safety of Soviet-designed civil nuclear power reactors, efforts are under way to study the radiological effects from operating nuclear facilities and nuclear-powered submarines, including their decommissioning. As of August 1995, the United States had committed approximately $55 million to support various programs that focus primarily on the environmental and health effects caused by the long-term production of nuclear weapons in the former Soviet Union. These programs are administered by DOD's Office of Naval Research, DOE, the Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), and the Trade and Development Agency (TDA). The largest program is a $30 million effort to study the impact of nuclear contamination in the Arctic seas.

Background

Beginning in the 1940s, the Soviet Union undertook a massive program to produce nuclear weapons. To support this program, a network of facilities was built, with most of the major ones located in Russia. Ten closed, or "secret," cities were built to house workers at the major sites. In the quest to produce nuclear weapons, the health and safety of workers—as well as the environmental impact of production—were not adequately considered. As the threat of nuclear confrontation has receded, the long-term

[2]The Arctic seas include, but are not limited to, the Barents and the Kara seas.

consequences of the Soviet's nuclear program are being examined more closely by international environmental and health experts. Since the breakup of the Soviet Union, information about many of the facilities, including levels of safety and environmental contamination, is becoming publicly available.

Nuclear Facilities and Radiation Sources in the Former Soviet Union

At least 221 nuclear facilities—other than civil nuclear power reactors—operate in the former Soviet Union.[3] (App. I lists the types of major facilities we identified and their locations.) These facilities cover a range of activities, such as (1) mining, milling, and processing uranium ore; (2) producing enriched uranium; (3) producing and processing nuclear materials and nuclear fuel; (4) assembling nuclear weapons; and (5) disposing of and storing nuclear waste.

The largest number of operating nuclear facilities are in Russia. Of the 221 facilities identified, 99 (or about 45 percent) are in Russia, including all of the Soviet Union's facilities to produce or reprocess plutonium. In addition, Russia maintains all of the facilities of the former Soviet Union that were used to design or assemble nuclear weapons. Russia also operates 31 of the 48 research, training, and experimental reactors. (See app. II for a list of research reactors in the former Soviet Union.)

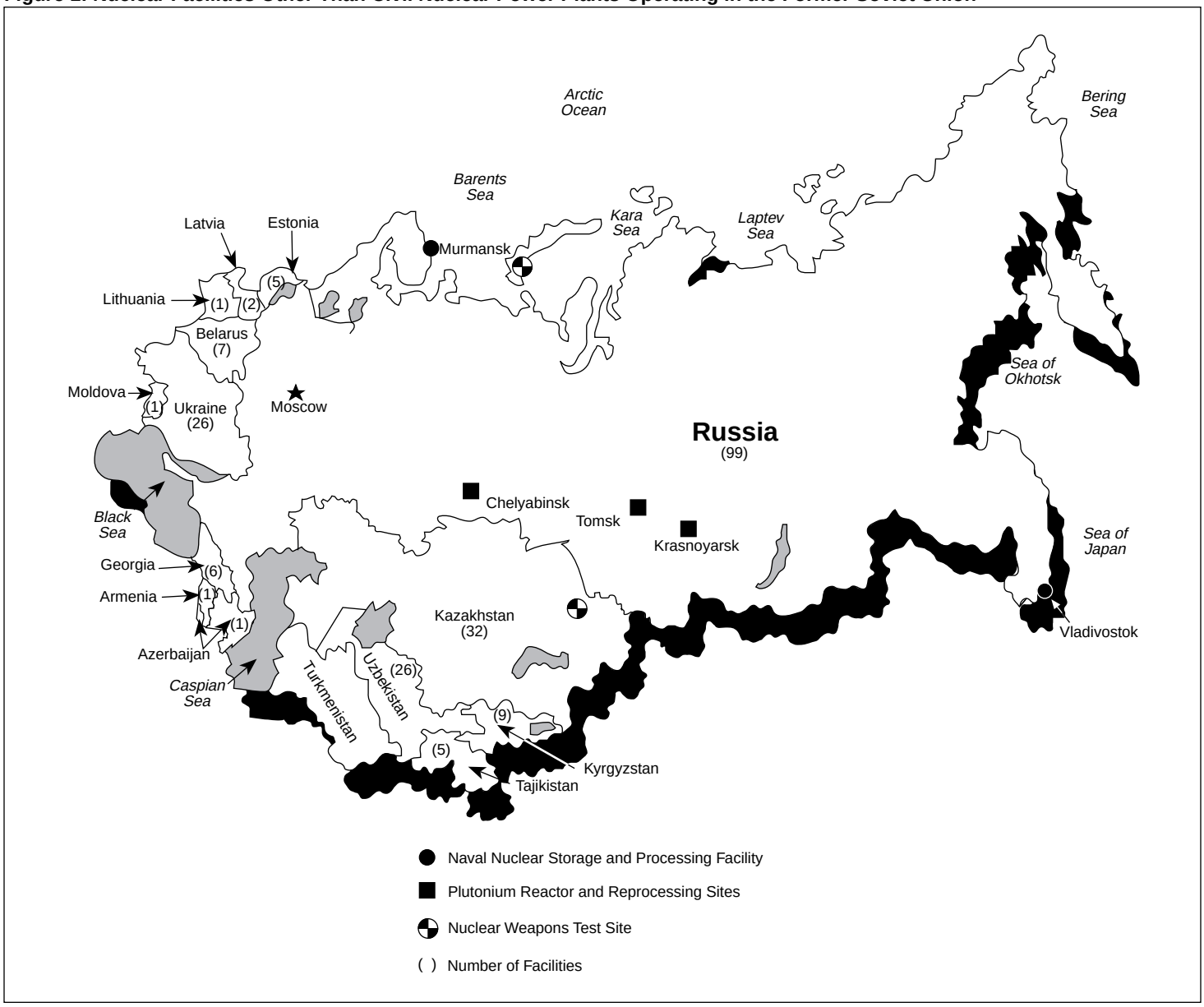
Most of the other countries of the former Soviet Union have nuclear facilities. For example, Kazakhstan operates a significant number of facilities, including five research reactors, one fuel fabrication plant, and at least 22 mining sites. It also contains what was a major nuclear testing area, Semipalatinsk, which closed in 1991. Ukraine has a large concentration of nuclear facilities, including research reactors and waste storage and disposal facilities. Uranium mining, milling, and ore processing is concentrated around the central Asian republics of Kazakhstan, Kyrgystan, Uzbekistan, and Tajikistan. These four republics and Ukraine have about 87 percent of the former Soviet Union's 78 mining, milling, and ore-processing sites.

In addition to the 221 operating nuclear facilities, Russia also has a fleet of nuclear-powered vessels, including 228 submarines, 7 icebreakers, and 1 transport ship. According to DOD, between 10,000 and 20,000 organizations in the former Soviet Union use different types of radiation sources in

[3]We obtained this information from various U.S. government agencies and international organizations, such as the International Atomic Energy Agency (IAEA).

medicine, industry, and research. Figure 1 shows the distribution of the nuclear facilities discussed in this report.

Figure 1: Nuclear Facilities Other Than Civil Nuclear Power Plants Operating in the Former Soviet Union



Note: The number of nuclear facilities shown by country includes uranium mining, milling, and ore-processing sites; waste processing, storage, and disposal sites; research, experimental, and training reactors; fuel fabrication, weapon assembly, weapon design laboratories; and uranium enrichment plants.

Concerns About the Safety of Russia's Plutonium Production Reactors and Reprocessing Facilities

DOE, International Atomic Energy Agency (IAEA), and European Union officials, as well as other nuclear safety experts, told us that certain nuclear facilities in the former Soviet Union, particularly those that are part of the weapons complex, present safety risks. During our discussions with these experts, the following five factors emerged as the main contributors to unsafe conditions: (1) lack of technology as well as aging facilities and equipment, (2) the lack of awareness and commitment to the importance of safety, (3) the long-standing emphasis on production over safety, (4) the absence of independent and effective nuclear regulatory bodies, and (5) the lack of funds to improve safety.

Several officials from DOE's national laboratories and nuclear weapons facilities noted similarities between aging U.S. and former Soviet Union plutonium production and reprocessing facilities. In 1988, we reported that aging and deteriorating U.S. facilities resulted in safety and/or operational problems.[4] DOE officials noted that while all of the U.S. plutonium production and reprocessing facilities have been closed, some of the former Soviet Union's aging facilities continue to operate.

DOE, IAEA, and European Union officials—as well as Russian officials—expressed concern about the safety of plutonium production reactors and associated reprocessing facilities at Krasnoyarsk, Tomsk, and Chelyabinsk. Two operating production reactors are located at Tomsk, and one is at Krasnoyarsk. Prior to 1987, 13 plutonium production reactors operated at these three sites. Ten of the reactors have been shut down. In 1994, Russia announced that it was no longer fully processing weapons grade plutonium at these sites and the plutonium was being placed in storage. The three remaining reactors continue to operate, however, and supply heat and electricity to nearby cities.[5] Although Chelyabinsk's production reactors were shut down several years ago, the site remains a major reprocessing center for spent fuel from civil nuclear power reactors and nuclear-powered submarines. While Russia plans to significantly expand its reprocessing capabilities at Krasnoyarsk, the project has stalled because of a lack of funding.

[4]Nuclear Health and Safety: Dealing With Problems in the Nuclear Defense Complex Expected to Cost Over $100 Billion (GAO/RCED-88-197BR, July 6, 1988).

[5]The United States operated a similar reactor at the Hanford site in Richland, Washington. The reactor was shut down in 1987. (See app. III for a comparison of U.S. and former Soviet Union nuclear weapons facilities.)

Russia's Plutonium Production Reactors and Reprocessing Plants Raise Concerns

Russia's three operating plutonium production reactors are over 30 years old and share design characteristics with Chernobyl-style reactors, including the lack of a containment structure. However, the Krasnoyarsk reactor is located underground thereby reducing the potential release of radioactive material to the environment. Russia has denied DOE officials permission to visit the operating reactors at Tomsk and Krasnoyarsk because of their military sensitivity. Although detailed safety analyses are not available to DOE officials, they believe the reactors have safety problems because of their design and age. According to a 1994 study conducted by Pacific Northwest Laboratory (PNL), the reactors were designed and operated without the benefit of safety improvements made at other nuclear facilities.[6] An official from Russia's Gosatomnadzor (GAN), the agency responsible for safety at nuclear fuel cycle facilities, including plutonium production reactors, told us that the reactors need extensive upgrades to continue long-term operations and are "unreliable." Furthermore, he noted that a small incident at one of these reactors could have "disastrous consequences." In June 1994, Russia agreed with the United States to shut down the three remaining production reactors not later than the year 2000. Because the reactors will not be closed until an alternative source of energy is available, the United States has agreed to help Russia evaluate various alternatives.

DOE, IAEA, and European Union officials told us that Russia's reprocessing facilities present safety concerns. Reprocessing involves the use of chemical processes to separate uranium and plutonium from spent nuclear fuel. Under certain conditions, the chemical solutions can cause an explosion. DOE officials obtained first-hand information about the conditions at Russia's reprocessing facilities after an accident at the Tomsk plant, which occurred in April 1993. In June 1993, DOE officials visited Tomsk to investigate the accident. Although they were not permitted to view the chemical tank that had exploded, they did see other parts of the facility. Several operational errors, such as improper mixing of chemicals in the reprocessing tank, and possible design flaws, such as inadequate tank ventilation, were identified as contributors to the accident.[7]

[6]D. Newman, C. Gesh, and E. Love, PNL, Summary of Near-Term Options for Russian Plutonium Production Reactors (July 1994).

[7]According to DOE, two similar but smaller accidents occurred at U.S. facilities in the 1950s and 1970s. Detailed information about the Tomsk accident is contained in two DOE reports: Trip Report Moscow and Tomsk, Russia, June 19-29, 1993, Follow-Up to the Tomsk-7 Accident (Sept. 1993) and Joint United States/Russian Federation Meeting on Radiochemical Processing Safety (Sept. 1993).

According to DOE officials, inadequate safety awareness at nuclear facilities in the former Soviet Union affects operational safety levels and increases the risks for accidents. DOE officials who visited Tomsk and Krasnoyarsk within the past 2 years in conjunction with a U.S.-Russian exchange program on reprocessing observed that the Russian safety practices were generally not comparable to U.S. practices. Despite their recent visits to Russian facilities, DOE officials said that they needed increased access to them—as well as more opportunities to discuss safety issues with their counterparts—to obtain a better understanding of the overall safety environment. A PNL official noted that access to and information about Russian facilities are improving. For example, he said that a U.S. team planned to visit the operating reactors at Tomsk and Krasnoyarsk in September 1995.

According to an official from the Russian Ministry of Atomic Energy (MINATOM), Russia's reprocessing facilities have many safety problems. MINATOM is responsible for most nuclear-related activities in Russia, including the weapons production complex and electricity generated by nuclear power. This official noted that since the breakup of the Soviet Union, the discipline of operators at these facilities has significantly deteriorated. He also said that the Soviet-era emphasis on meeting production goals rather than maintaining safety had hampered efforts to improve safety, which was better at other nuclear facilities, such as research institutes and design laboratories. An official from Russia's nuclear regulatory body told us that although safety is becoming more important at Russian facilities, it is difficult to undo problems created many years ago.

According to NRC, although GAN is Russia's nuclear regulatory agency, it does not have the legal authority—backed by national legislation—to exercise strong and independent oversight; nor has it been adequately funded to carry out its mission. According to information furnished by DOE, although a 1992 Russian presidential decree gave GAN the overall responsibility for inspecting and licensing activities that involve handling radioactive material, its inspectors are not empowered to enforce compliance. The head of GAN's nuclear fuel cycle enterprises, which are responsible for the safety of production reactors and reprocessing plants, told us that his agency's regulatory authority is limited. He noted that although some safety changes were made, many recommendations GAN made after the Tomsk accident have been ignored. A 1994 Russian report noted that GAN had a skeletal staff supervising safety—only 22 percent of the authorized slots were filled—at nuclear weapons facilities.

Furthermore, this report said that GAN was unable to carry out its responsibilities because the Russian Ministry of Defense had created obstacles to prevent inspections at nuclear defense facilities.

DOE officials who have visited Russian nuclear facilities told us that accidents at nuclear facilities in the former Soviet Union—other than civil nuclear power reactors—would not be of the magnitude of the Chernobyl accident. Most of the accidents that have been reported at these facilities did not have widespread radiological consequences.[8] For example, while the 1993 accident at the Tomsk reprocessing facility caused substantial damage to the facility, it contaminated a largely unpopulated area of about 123 square kilometers. The accident released a relatively small amount of contamination—about 40 curies—compared to approximately 50 million curies released after the Chernobyl accident.[9] The Tomsk accident could have had more serious local consequences if the wind had carried the contamination to two large nearby cities. According to available information, most accidents and incidents—at facilities other than civil nuclear power reactors—have occurred at reprocessing plants in Russia. More than one-half of these accidents occurred from the 1950s through the 1970s. (See app. IV for more details about accidents at facilities in the former Soviet Union.)

Waste From Facilities Contaminates the Environment

The environmental contamination caused by past and current practices at nuclear facilities in the former Soviet Union, especially Russia, is a more immediate concern than potential accidents. These facilities have generated massive amounts of nuclear waste and contamination that have created environmental problems. The possible migration of this contamination may also pose some risks to neighboring countries. For example, within the past few years there has been scientific and congressional concern that Alaska could be affected by this contamination.

The majority of nuclear waste contamination is concentrated in Russia. Three plutonium production and reprocessing sites have been identified as the major sources of nuclear waste contamination from years of improper disposal practices. According to a June 1995 analysis prepared by a PNL

[8]One notable exception occurred in 1957 when a storage tank for high-level radioactive waste exploded at Chelyabinsk. This explosion, and its aftermath, known as the "Kyshtym Disaster," caused widespread radiation contamination. According to a 1991 PNL report, the total area of contamination was 23,000 square kilometers.

[9]A curie is a measure of the intensity of radioactive material.

scientist, the current level of discharge of radioactive material to the environment at these three sites is approximately 600 times greater than the remaining contamination from various other nuclear sources in Russia combined.[10] This analysis also notes that the current radioactive inventory released from the nuclear weapons complex in Russia is approximately 1.7 billion curies, compared to about 2.6 million curies released by the U.S. nuclear weapons complex.

Soviet-era nuclear waste practices have left a lasting imprint on Russia's environment. For example, starting in the late 1940s, radioactive waste from the Chelyabinsk facilities was released directly into the Techa River and nearby lakes, buried at the site, and stored in tanks. According to DOE, although the direct discharge of radioactive waste into rivers and lakes was curtailed many years ago, the cumulative effect has left some areas uninhabitable. As the contamination migrates, it threatens the groundwater supplies and waterways that flow into the Arctic Ocean. As a result of releases from Chelyabinsk, about 18,000 people were relocated and more than 440,000 people received an elevated dose of radiation. Beginning in the 1960s, the Soviet Union began to inject liquid radioactive waste into deep underground wells, a practice that has been used extensively at both Tomsk and Krasnoyarsk.

Radioactive waste from other facilities and activities throughout the former Soviet Union have caused contamination problems. For example, Kazakhstan's Semipalatinsk and Russia's Novaya Zemlya test sites for nuclear weapons were used by the Soviets for approximately 40 years. Estonia has radioactivity problems resulting from Soviet nuclear submarine training reactors that operated at Paldiski. Uranium tailings—radioactive particles and other hazardous materials—resulting from mining, milling, and ore processing have caused contamination in several republics of the former Soviet Union.

Nuclear-Powered Submarines and Ships Are Sources of Radioactive Contamination

Environmental concerns resulting from Russia's nuclear fleets have received increased international attention in recent years. The primary source of concern is radioactive contamination from Russia's nuclear submarines and nuclear-powered civilian icebreakers. Most of the concerns stem from four main sources: (1) the dumping of damaged submarine and icebreaker reactors into the Kara Sea, (2) submarine accidents, (3) the dumping of liquid and solid radioactive waste from the

[10]Don J. Bradley, PNL, Overview of Contamination From U.S. and Russian Nuclear Complexes, presented at the NATO Advanced Research Workshop on Nuclear Submarine Decommissioning and Related Problems, Moscow, Russia (June 1995).

Russian fleets into the Kara and Barents seas and the Sea of Japan, and (4) the inadequate treatment of and storage capacity for fuel from nuclear-powered vessels.

In 1993, the Russian government released a report describing over three decades of Soviet-era dumping of radioactive material in the ocean.[11] The report noted that during this time, the former Soviet Union dumped 2 reactor compartments without spent nuclear fuel into the Sea of Japan and 16 reactors into the Kara Sea, 6 of which contained spent or damaged fuel.

The report also cited submarine accidents as a source of radioactive contamination. In August 1985, a submarine accident at a shipyard near Vladivostok released significant amounts of radioactive material. In 1989, the submarine, Komsomolets, sank approximately 300 miles from Norway after a fire disabled the vessel. Although the submarine had nuclear fuel in its reactor and nuclear warheads on board when it sank, Russian and international expeditions have not found evidence of substantial contamination around the sunken vessel.

Because Russia does not have adequate treatment and storage facilities for radioactive waste, it has not signed a 1993 amendment to Annex I, section 6, of the London Convention.[12] This amendment prohibits the dumping of all radioactive waste or other radioactive matter, including low-level liquid waste, into the seas. In September 1994, Russia announced that it intended to continue to voluntarily comply with the ban on low-level liquid waste dumping. However, according to several U.S., international, and Russian reports, Russia has a severe shortage of adequate waste storage and disposal facilities for liquid waste as well as for spent fuel assemblies and decommissioned nuclear-powered submarines. An EPA official who recently visited Russia told us that Russian naval officials believe the decommissioned submarines pose an increasingly significant safety hazard.

The international community, including the United States, has conducted several studies to assess the impact of Russia's nuclear waste disposal practices on neighboring waterways, including the Arctic seas. Although these studies have not indicated significant contamination around the

[11]Report by the Russian Government Commission on Matters Related to Radioactive Waste Disposal at Sea, Facts and Problems Related to Radioactive Waste Disposal in Seas Adjacent to the Territory of the Russian Federation (Mar. 1993). This report is more commonly referred to as the "Yablokov Report."

[12]This convention had formerly been known as the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

dump sites, they have not ruled out future problems. In a January 1995 report, the Office of Naval Research stated that nuclear waste in the Arctic and North Pacific regions poses no immediate threat to Alaskan citizens or its resources.[13] According to an EPA official, there is reason to believe that the high-level radioactive material associated with the dumped reactors has yet to be released. Because this radioactive waste may start to enter the marine environment within a few years, the effects of this future contamination is uncertain.

Inadequate Control of Other Radiation Sources Poses Threats of Radiation Exposure and Contamination

Some officials, including the Nuclear Safety Attache to the U.S. Mission (in Vienna, Austria) and IAEA's Deputy Director, Division of Nuclear Safety, have expressed concerns to us about the inadequate control of radiation sources used in medicine, agriculture, research, and industry throughout the former Soviet Union. In May 1993, similar concerns were noted by several representatives from the former Soviet Union who were attending an IAEA forum on strengthening radiation protection and nuclear safety. The small size, portability, and value of these sources make them susceptible to misuse, improper disposal, or theft.

Countries of the former Soviet Union have not established adequate systems to register, control, monitor, or account for radiation sources. These sources had been loosely controlled under the Soviet Union, but with its dissolution, the loss of centralized authority has left the new republics without adequate legal and regulatory structures. Representatives of some former Soviet Union republics have voiced concerns about the need to bring radiation sources under control, and some have admitted they do not know how many are still in use within their countries.

Without an adequate control system, radiation sources may be lost, abandoned, stolen, or improperly disposed of, thereby creating the potential for human radiation exposure and localized environmental contamination. Numerous incidents involving the exposure of persons and contamination of areas have occurred over the past several years. For example, in 1994 a stolen source of radiation caused the death of a man and serious injury to his son in Estonia. In addition, the lack of control creates the potential for illicit trafficking of radiation sources to other countries.

[13]Office of Naval Research, Department of Defense Arctic Nuclear Waste Assessment Program, Fiscal Years 1993-94 (Jan. 1995).

U.S. and International Assistance for Nuclear-Related Activities in the Former Soviet Union

Several U.S. and international efforts focus on radioactive waste, radiation protection, and other related activities in the former Soviet Union. Collectively, these efforts are smaller in number and resources than programs aimed at improving the safety of Soviet-designed civil nuclear power reactors. Several U.S. and international officials told us that these reactors pose the most serious safety risk and require immediate attention.[14]

International Assistance Efforts

About a dozen countries and international organizations are providing assistance for projects related to, among other things, radiation protection and radioactive waste management in countries of the former Soviet Union. Among the countries providing assistance are Norway, Sweden, and Japan, which are all in close proximity to the former Soviet Union. These countries are concerned about the migration of contamination from nuclear facilities and other sources of radioactivity. According to an official from Norway's Ministry of Foreign Affairs, Norway plans to spend about $20 million in 1995 on radiation protection and waste management projects. A Swedish official has estimated that Sweden has already spent about $10 million for similar projects. Japan plans to assist in underwriting the establishment of a joint venture between a Russian firm and a Japanese firm to construct and operate a storage and processing facility for liquid radioactive waste from the Russian Pacific Fleet. IAEA has initiated a program broadly aimed at strengthening radiation protection in the former Soviet Union. (See app. V for additional information about international assistance efforts.)

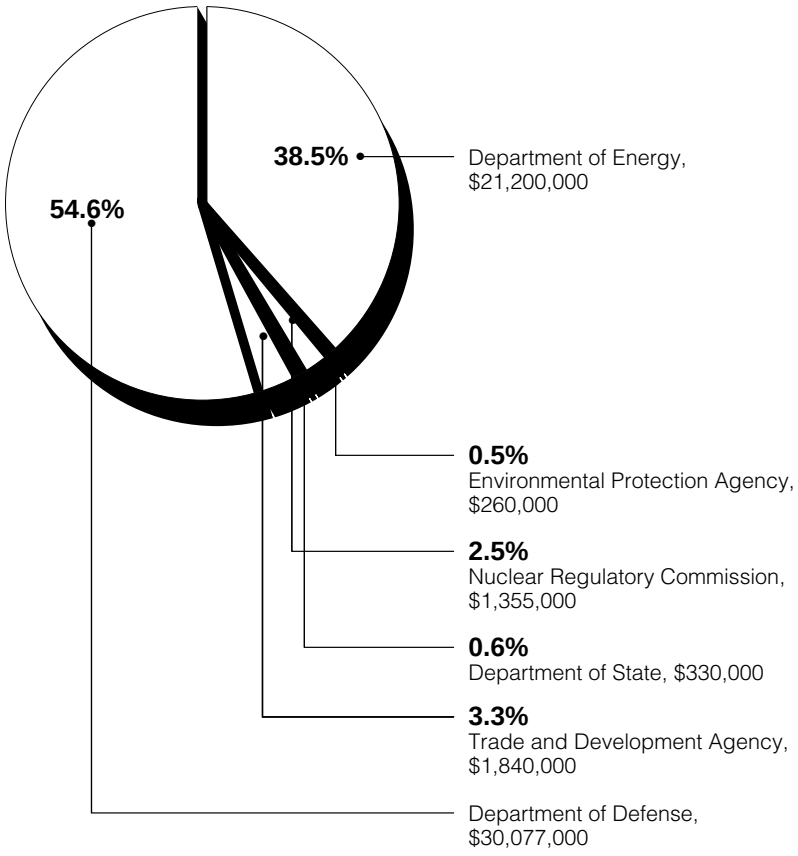
Planned and Ongoing U.S. Activities

As of August 1995, the United States had committed about $55 million to support various programs that primarily focus on the environmental and health effects of the long-term operation of the former Soviet Union's nuclear weapons production complex, including activities associated with the production and processing of plutonium. The objective is to channel a modest amount of funds to primarily study issues of concern, such as the effects of radioactive waste contamination because of its potential impact on Alaska. The United States is not providing direct assistance to help remediate the nuclear waste contamination in the former Soviet Union. DOE is not authorized to provide such assistance, and both DOE and State Department officials said that such aid could be very costly because of the magnitude of the contamination problems.

[14]In our report Nuclear Safety: International Assistance Efforts to Make Soviet-Designed Reactors Safer (GAO/RCED-94-234, Sept. 29, 1994), we noted that as of May 1994, about $785 million had been pledged by 22 nations and international organizations to improve the safety of Soviet-designed reactors.

DOE, which is responsible for managing the cleanup of the U.S. nuclear weapons complex, faces a major challenge to clean up the radioactive waste generated by more than four decades of nuclear weapons production. As a result, DOE is interested in acquiring innovative nuclear waste cleanup technologies from foreign countries through technology exchanges and other cooperative programs. DOE believes that its environmental programs with countries of the former Soviet Union should provide some tangible benefits to accelerate the cleanup of the U.S. nuclear weapons complex. For example, DOE hopes to identify new cleanup technologies that could improve remediation at U.S. facilities through a $2 million technical cooperation program with Estonia. Additionally, DOE is contracting with various Russian and Ukrainian research institutes to identify cleanup technologies. Figure 2 summarizes the planned distribution of U.S. funding as of August 1995.

Figure 2: U.S. Planned Distribution of About $55 Million as of August 1995



Note 1: Assistance from the Department of State includes $300,000 for the IAEA's program of radiation protection in the former Soviet Union.

Note 2: Percentages based on an amount equal to $55 million.

Sources: DOE, EPA, NRC, TDA, the Department of State, and DOD.

As of March 31, 1995, about half of the $55 million had been disbursed by DOD, DOE, NRC, and the State Department. Of that amount, about $10 million has been spent for studying radioactive waste contamination, including $9 million to study Russian nuclear contamination of the Arctic region. (App. VI lists the expenditures by agency.)

Specifically, U.S. programs focus on

- studying the disposal of nuclear waste by the former Soviet Union in the Arctic region (DOD/Office of Naval Research);
- assessing the radioactive waste contamination at a naval nuclear training facility in Estonia (DOE);
- developing technology on a cooperative basis with Russia to clean up radioactive waste (DOE);
- studying the health consequences of radiation contamination at Chelyabinsk and other locations in the former Soviet Union (DOE and DOD);
- upgrading and expanding a Russian facility that processes low-level liquid radioactive waste to prevent its continued dumping in the Arctic seas (EPA and Department of State);
- helping Russian and Ukrainian regulatory authorities establish regulatory control over radioactive materials, including the fuel cycle, the industrial and the medical uses of radioisotopes, and the disposal of radioactive materials (NRC); and
- studying options to replace power and steam lost as a result of the shutdown of the plutonium production reactors at Tomsk and Krasnoyarsk (TDA).

(See app. VII for additional details about the status of these U.S. programs.)

Observations

Information about the conditions at nuclear weapons facilities in the former Soviet Union is still emerging. With the exception of the plutonium production plants in operation, experts do not believe the other facilities present as broad a safety risk as Soviet-designed civil nuclear power reactors. The most immediate problem posed by these facilities is the extensive radioactive pollution that is the by-product of almost 50 years of nuclear weapons production. Recognizing that the costs associated with remediation are potentially enormous, the United States is committing modest resources for various environmental and health-related programs in some countries of the former Soviet Union.

Sharing common problems associated with the cleanup of their respective nuclear weapons complexes, the United States and the countries of the former Soviet Union can benefit from mutual cooperation on both safety and environmental issues. The U.S. government has recognized the potential benefits of this cooperation and is undertaking some efforts with

various Russian institutes to identify new cleanup technologies for potential use in the United States.

Ultimately, the countries of the former Soviet Union are responsible for the safety of their nuclear facilities. Without independent and effective regulatory oversight, sustaining any safety improvements will be very difficult. For example, the strengthening of Gosatomnadzor as the regulatory body responsible for inspecting these facilities in Russia may be one of the most effective ways to improve safety at weapons complex facilities that do not meet safety requirements. The absence of nuclear laws in Russia, however, limits its effectiveness in carrying out its regulatory duties.

Agency Comments

We provided copies of a draft of this report to the Departments of Defense, Energy, and State; EPA; and NRC for their review and comment. DOE and State had no comments. We met with DOD officials, including the Senior Nuclear Weapon Safety Specialist, Office of the Assistant to the Secretary of Defense, Atomic Energy. We also met with EPA officials, including the Acting Science Adviser to the Assistant Administrator, Office of International Activities. Both DOD and EPA generally agreed with the report's findings and provided clarifying information that we have incorporated in the text, as appropriate. NRC, while generally agreeing with our report, noted that we should have included the issue of safeguarding nuclear material in our discussion about nuclear safety and also indicated that Russia's nuclear regulatory authority may have been diminished. Regarding the first point, we recognize that safeguarding nuclear material is an important issue but our report focused primarily on the operational safety of nuclear facilities in the former Soviet Union. A forthcoming GAO report will address U.S. assistance to improve methods of safeguarding nuclear material at facilities in the former Soviet Union. Regarding the last point, in September 1995 the Acting Deputy Chairman of GAN, Russia's nuclear regulatory body, informed us that some of its functions were limited by a recent presidential decree. He noted, however, that GAN is responsible for inspecting plutonium production reactors and reprocessing facilities. (See app. IX for NRC's comments and our response to them.) We also discussed information presented in the draft of this report with TDA's Country Manager, New Independent States, who provided some clarifying information that we have incorporated, where appropriate.

We also provided copies of the draft report to the European Union and the IAEA. The European Union noted that the most urgent issue is to establish appropriate local organizations in the former Soviet Union to develop a complete inventory of all radiation sources.

Scope and Methodology

To address our objectives, we interviewed officials and reviewed documentation from the Department of State, DOD, DOE and several of its national laboratories, NRC, and EPA. We also met with Russian officials who are knowledgeable about nuclear facilities in their country, as well as officials from international organizations, including the IAEA. Collectively, these experts have provided their insights concerning the safety of these facilities and the environmental impact from their operation. Appendix VIII explains our scope and methodology. We performed our work between September 1994 and August 1995 in accordance with generally accepted government auditing standards.

Copies of this report are being sent to the Secretaries of State, Defense, and Energy; the Chairman of NRC; the Administrator of EPA; the Director of the Office of Management and Budget; the Director of the Trade and Development Agency; and interested congressional committees. 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 X.

Sincerely yours,

Victor S. Rezendes
Director, Energy and
Science Issues

Contents

Abbreviations

DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
GAN	Gosatomnadzor
IAEA	International Atomic Energy Agency
MINATOM	Russian Ministry of Atomic Energy
NRC	Nuclear Regulatory Commission
OECD	Organization for Economic Cooperation and Development
PNL	Pacific Northwest Laboratory
TDA	Trade and Development Agency

Nuclear Facilities Operating in the Former Soviet Union

	Country														
Nuclear facility and site	**ARM**	**AZR**	**BEL**	**EST**	**GEO**	**KAZ**	**KYR**	**LAT**	**LIT**	**MLD**	**RUS**	**TJK**	**UKR**	**UZB**	**Total**
Mining, milling, and ore- processing sites[a]				1		22	8				9	5	11	22	78
Waste storage and disposal facilities and spent fuel storage facilities	1	1	4	4	3	4	1	1	1	1	36		12	2	71
Research, experimental, and training reactors and critical assemblies			3		3	5		1			31		3	2	48
Uranium enrichment facilities											4				4
Fuel fabrication facilities						1					5				6
Plutonium and tritium production reactors											5				5
Weapon assembly facilities											4				4
Plutonium-processing and reprocessing facilities											3				3
Weapon design laboratories											2				2
Total	**1**	**1**	**7**	**5**	**6**	**32**	**9**	**2**	**1**	**1**	**99**	**5**	**26**	**26**	**221**

Legend: ARM = Armenia, AZR = Azerbaijan, BEL = Belarus, EST = Estonia, GEO = Georgia, KAZ = Kazakhstan, KYR = Kyrgystan, LAT = Latvia, LIT = Lithuania, MLD = Moldova, RUS = Russia, TJK = Tajikistan, UKR = Ukraine, UZB = Uzbekistan

Note 1: This table may not list all operating nuclear facilities and does not include nuclear-powered submarines, icebreakers, and support ships in the Russian military and civilian fleets. It also does not include the nuclear test sites at Novaya Zemlya (Russia) and Semipalatinsk (Kazakhstan) because they were closed down in October 1990 and August 1991, respectively.

Note 2: Empty cells in this table indicate that no known facilities are located at these locations.

[a]There are many more possible mining sites. They are not included because of incomplete data or because they may not be operational. In addition, because some sites overlap two countries' borders they are included in both.

Sources: DOD, International Atomic Energy Agency, Pacific Northwest Laboratory, Monterey Institute of International Studies, the Kurchatov Institute, the Natural Resources Defense Council, and others.

Research Reactors in the Former Soviet Union

According to Russian nuclear experts, there are 41 research reactors in the former Soviet Union, 31 of which are in Russia. Of the 41 research reactors, 5 have suspended operation, 1 is under reconstruction and 1 is under construction. Table II.1 shows the name, location, and operating information for these research reactors.

Table II.1: Research Reactors in the Former Soviet Union

Name, type, operator, and location of reactor by republic	Power of reactor	Fuel enrichment (percent of uranium- 235)	Amount of uranium-235 in fuel (in kilograms)
Kazakhstan			
WWR-K, tank type (Institute of Nuclear Physics, Alma Ata)[a]	10,000 kilowatts	36	5.4
IGR, graphite impulse type (Semipalatinsk Test Site)	5,200 megajoules[b] per impulse	90	9.0
IVG-1M, water-cooled impulse type (Semipalatinsk Test Site)	60,000 kilowatts	90	4.6
RA, experimental gas-cooled (Semipalatinsk Test Site)	400 kilowatts	90	10
Latvia			
IRT-M, pond type (Institute of Nuclear Physics, Riga)	5,000 kilowatts	90	3.6-4.0
Russia			
WWR-2, tank type (Kurchatov Institute)[c]	2,000 kilowatts	10	3.1-6.1
IR-8, pond type (Kurchatov Institute)	8,000 kilowatts	90	3.6-4.0
MR, pond type (Kurchatov Institute)	40,000 kilowatts	90	4.0-20.0
Hydra (IIN), solution impulse type (Kurchatov Institute)	30 megajoules per impulse	90	2.4
Argus, solution type (Kurchatov Institute)	50 kilowatts	90	2.8
F-1, uranium-graphite type without forced cooling (Kurchatov Institute)	25 kilowatts	0.7	340
GAMMA, vessel type (Kurchatov Institute)	125 kilowatts	36-90	4.0-8.0
OR, pond type (Kurchatov Institute)	300 kilowatts	36	6.2-8.3
TWR, heavy water vessel type (Institute for Theoretical and Experimental Physics, Moscow)	2,500 kilowatts	80	6
IRT, pond type (Engineering and Physics Institute, Moscow)	5,000 kilowatts	90	3.6
WWR-C, tank type (Branch of Scientific and Research Physics-Chemistry Institute, Obninsk)	13,000 kilowatts	90	4.0-12.0
AM, uranium-graphite type (Institute of Physics and Power Engineering, Obninsk)	30,000 kilowatts	5-7	100-200
BR-10, fast breeder sodium cooled type (Institute of Physics and Power Engineering, Obninsk)	10,000 kilowatts	plutonium	150 kilograms of plutonium
BFS-1, fast reactor without forced cooling (Institute of Physics and Power Engineering, Obninsk)	1 kilowatt	plutonium	250 kilograms of plutonium

(continued)

Name, type, operator, and location of reactor by republic	Power of reactor	Fuel enrichment (percent of uranium- 235)	Amount of uranium-235 in fuel (in kilograms)
BFS-2, fast reactor without forced cooling (Institute of Physics and Power Engineering, Obninsk)	5 kilowatts	plutonium	750 kilograms of plutonium
IBR-30, fast reactor of pulse type (Institute of Nuclear Research, Dubna)	30 kilowatts	90	70
IBR-2, fast reactor of pulse type (Institute of Nuclear Research, Dubna)	2,000 kilowatts	90	150
WWR-M, pond type (St. Petersburg's Institute of Nuclear Physics)	18,000 kilowatts	90	4.0-6.0
PIK, tank-vessel type (St. Petersburg's Institute of Nuclear Physics)[d]	100,000 kilowatts	90	27.5
IVV-2M, pond type (Ural Nuclear Center, Ekaterinburg, Branch of Research and Construction Institute for Energy Technique, Moscow)	15,000 kilowatts	90	4.0-6.0
MIR, vessel type (Institute of Atomic Reactors, Dimitrovgrad)	100,000 kilowatts	90	30
SM-2, vessel type (Institute of Atomic Reactors, Dimitrovgrad)	100,000 kilowatts	90	40
RBT-10/1, pond type (Institute of Atomic Reactors, Dimitrovgrad)	10,000 kilowatts	50-85[e]	12-25
RBT-10/2, pond type (Institute of Atomic Reactors, Dimitrovgrad)	10,000 kilowatts	50-85[e]	12-25
RBT-6, pond type (Institute of Atomic Reactors, Dimitrovgrad)	6,000 kilowatts	50-85[e]	12-25
BIGR, uranium-graphite impulse type with air cooling, (Institute of Experimental Physics, Arzamas-16)	2,500 megajoules per impulse	90	7
BR-1, uranium-metal impulse type (Institute of Experimental Physics, Arzamas-16)	50 megajoules per impulse	90	350
BIR-2M, uranium-metal impulse type (Institute of Experimental Physics, Arzamas-16)	5 megajoules per impulse	85	90
VIR-2M, solution impulse type (Institute of Experimental Physics, Arzamas-16)	81 megajoules per impulse	90	7
IRT-T, pond type (Institute of Nuclear Physics of Tomsk Polytechnics Institute, Tomsk)	12,000 kilowatts	90	3.6-4.0
WWR-T, tank type (Norilsk Mining Combine)	12,000 kilowatts	90	3.6-4.0
Ukraine			
WWR-M, tank type (Institute for Nuclear Research, Kiev)[a]	10,000 kilowatts	36	6.2-8.3
IR-100, pond type (Navy Institute of the Ministry of Defense, Sevastopol, Crimea)[a]	100 kilowatts	10	3.1-6.1
Belarus			
IRT-M, pond type (Institute of Nuclear Power, Minsk)[a]	5,000 kilowatts	90	3.6-4.0
Georgia			
IRT-M, pond type (Institute of Nuclear Physics, Tbilisi)[a]	5,000 kilowatts	90	3.6-4.0
Uzbekistan			
WWR-CM, tank type (Institute of Nuclear Physics, Tashkent)	10,000 kilowatts	90	3.6-4.0

(Table notes on next page)

[a]Operation suspended.

[b]The output of impulse reactors is measured in megajoules. A megajoule is equivalent to an output of one thousand kilowatts for one second.

[c]Under reconstruction.

[d]Under construction.

[e]Spent fuel of SM-2 reactor.

Source: Kurchatov Institute, Moscow, Russia.

Equivalent U.S. and Former Soviet Union Nuclear Weapons Facilities

Activity	Facility[a]	U.S. Equivalent[b]
Uranium enrichment	Angarsk Krasnoyarsk-45 Sverdlovsk-44 Tomsk-7	Oak Ridge, Tennessee Portsmouth, Ohio Paducah, Kentucky
Fuel fabrication	Glazov Elektrostal Novosibirsk	Savannah River, South Carolina Fernald, Ohio Ashtabula Plant, Ohio
Plutonium and tritium production and processing	Chelyabinsk-65 Krasnoyarsk-26 Tomsk-7	Savannah River, South Carolina Hanford, Washington Rocky Flats, Colorado[c]
Weapon design laboratories	Arzamas-16 Chelyabinsk-70	Los Alamos, New Mexico Lawrence Livermore, California
Assembly and disassembly of weapons	Avangard Penza-19 Sverdlovsk-45 Zlatoust-36	Pantex, Texas
Special nuclear material storage	Chelyabinsk Krasnoyarsk Tomsk	Pantex, Texas Oak Ridge, Tennessee

[a]All the facilities are located in Russia. The numeric designation next to a site was adopted during the Soviet era to identify locations.

[b]The facilities at Oak Ridge, Portsmouth, Paducah, Savannah River, Hanford, and Rocky Flats are no longer used in nuclear weapons production activities.

[c]There were no plutonium production facilities at Rocky Flats.

Sources: Various U.S. government organizations.

Accidents and Incidents at Nuclear Facilities in the Former Soviet Union

Year	Location	Activity	Accident, incident, and/or impact
1954	Chelyabinsk-65	Reprocessing	Parts of building and equipment destroyed
1957	Chelyabinsk-65	Reprocessing	Six persons hurt; one fatality
1957	Chelyabinsk-65	Reprocessing	High-level waste storage facility exploded; widespread contamination; over 10,000 people evacuated
1958	Chelyabinsk-65	Reprocessing	Three fatalities; one case of radiation sickness[a]
1959	Chelyabinsk-65	Reprocessing	Equipment damaged[a]
1960	Chelyabinsk-65	Reprocessing	No irradiation[a]
1961	Tomsk-7	Reprocessing	Explosion caused two fatalities[a]
1962	Chelyabinsk-65	Reprocessing	Explosion destroyed pipelines
1962	Chelyabinsk-65	Reprocessing	No personnel irradiated[a]
1963	Tomsk-7	Reprocessing	Four workers received large doses of radiation
1963	Tomsk-7	Reprocessing	No personnel irradiated[a]
1965	Chelyabinsk-65	Reprocessing	[b]
1967	Chelyabinsk-65	Waste disposal (Lake Karachay)	Off-site contamination when lake dried; winds blew radioactive silt over tract 75 km. long and 1,800-2,700 square km.; over 63 settlements with 41,500 inhabitants affected
1967	Tomsk-7	Reprocessing	Explosion in reprocessing equipment
1968	Chelyabinsk-65	Reprocessing	One fatality; one case of severe radiation sickness requiring amputation of legs
1970s	Tomsk-7	Reprocessing	Some equipment destroyed
1984	Chelyabinsk-65	Reprocessing	Explosion in reprocessing equipment
1987	Chelyabinsk-65	Waste vitrification	Electrode failed in ceramic melter and contents spilled onto building floor; furnace decommissioned in February 1987
1987	Krasnoyarsk-26	Reprocessing	Radioactive contamination of drainage passage
1990	Kamchatka Peninsula	Nuclear waste storage	Leak in storage site for untreated high-level waste
1990	Chelyabinsk-65	Reprocessing	Explosion in reprocessing equipment; two men received chemical burns and one died
1991	Tomsk-7	Reprocessing	Radioactive gas contamination
1993	Chelyabinsk-65	Reprocessing	Two technicians irradiated[a]
1993	Tomsk-7	Reprocessing	Large reprocessing tank exploded causing extensive plant damage and off-site contamination that spread over mostly forested area of approximately 123 square km.; no worker injuries reported
1993	Chelyabinsk-65	Reprocessing	Plutonium gases released by the plant's ventilation system; no damage to the workshop or worker injuries

(continued)

Year	Location	Activity	Accident, incident, and/or impact
1993	Chelyabinsk-65	Water pumping station	Low-level radioactive water escaped and contaminated approximately 100 square meters
1994	Chelyabinsk-65	Reprocessing	Spent fuel rod's protective coating caught fire during reprocessing; small amount of radioactive gas released

Note: This table may not be a complete listing of accidents. Additionally, it does not include nuclear-powered submarine accidents.

[a]No additional information available.

[b]No information available.

Sources: International Atomic Energy Agency, Westinghouse Savannah River Corporation, Natural Resources Defense Council, and others.

International Assistance for Nuclear Safety and Radiation Protection to the Former Soviet Union

Although the majority of international nuclear assistance to the countries of the former Soviet Union is focused on the safety of Soviet-designed civil nuclear power reactors, the international community is also providing some assistance related to radiation protection, radioactive waste management, and other activities not directly related to the nuclear power reactors. About a dozen countries and international organizations are involved in these other bilateral and multilateral assistance projects. Because there is no comprehensive compilation of this international assistance, estimating exactly how much each country has committed to promote nuclear safety and radiation protection issues other than civil nuclear power activities is difficult. Appendix VII describes U.S.efforts in this area.

According to an official of Norway's Ministry of Foreign Affairs, Norway's assistance focuses largely on Russia, Estonia, Lithuania, and Ukraine with a primary concern for environmental health. About two-thirds of Norway's nuclear assistance is focused on radiation protection and radioactive waste management, and assistance for these areas is expected to be about $20 million for 1995. One of Norway's greatest concerns has been the dumping of nuclear waste in the Arctic seas. As a result, the Norwegian Parliament has approved a plan to address this problem and Norway has participated in several marine expeditions to assess radioactive contamination in the Kara and Barents seas.

Sweden's assistance in radiation protection and waste management has focused primarily on the Baltic countries (i.e., Estonia, Latvia, and Lithuania), Belarus, and Russia. Assistance projects have varied greatly and included studying radioactive contamination in the Arctic Ocean, providing equipment to detect radiation, environmental monitoring, installing emergency warning systems, and assessing nuclear waste management problems. A Swedish official estimated that Sweden has already spent around $10 million for these projects.

Japan's assistance includes efforts to avoid further dumping of radioactive waste in the Sea of Japan. As recently as 1993, Russia dumped a large volume of low-level liquid radioactive waste into the Sea of Japan from its fleet of nuclear-powered submarines based near Vladivostok. In response to the dumping of this waste, the Japanese government agreed to assist in underwriting a joint venture between a Russian firm and a Japanese firm to construct and operate a facility to store and process low-level liquid radioactive waste. As of August 1995, construction had not begun on this facility.

In 1993, the International Atomic Energy Agency (IAEA), in conjunction with the United Nations Development Program, initiated a program to strengthen radiation protection and nuclear safety infrastructures as well as identify the types of assistance needed in the former Soviet Union. As of May 1995, IAEA had completed fact-finding missions to nine countries—Armenia, Belarus, Estonia, Latvia, Lithuania, Kazakhstan, Kyrgyzstan, Moldova, and Uzbekistan. IAEA plans to conduct missions to the remaining countries of the former Soviet Union. In October 1994, IAEA identified approximately $19 million to implement the assistance packages developed for these countries. As of May 1995, IAEA had provided some equipment under this program, such as radiation-monitoring devices, to four countries through emergency IAEA funding and some additional assistance through its regular technical cooperation program.

IAEA is awaiting funding to implement the proposed assistance packages. In 1995, the United States agreed to provide $300,000 to support IAEA programs in Moldova and Uzbekistan. The funds will provide (1) a national system to notify, register, and license radiation sources; (2) training to ensure national capability to track the disposition of radiation sources; and (3) a mechanism to manage radioactive waste through training, technical assistance, and equipment.

The European Union also provides nuclear assistance to the former Soviet Union.[15] Although about 95 percent of the European Union's funding for safety assistance is targeted to nuclear power reactors, the remaining 5 percent, or about $3.9 million, funds a variety of projects for radiation protection and radioactive waste management. These projects include (1) assessing the extent of radioactive waste contamination in the Barents Sea and the Sea of Japan; (2) supporting countries' regulatory authorities; and (3) preparing site remediation plans at uranium mines.

[15]The European Union, formerly the European Community, consists of the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

U.S. Expenditures to Support Nuclear-Related Activities in the Former Soviet Union (Other Than Civil Nuclear Power Plants), March 31, 1995

Expenditure	Amount
Department of Defense	
Study of radioactive waste contamination in the Arctic region and its effect on Alaska	$9,069,000
Studies of long-term radiation releases in Russia and Kazakhstan	77,000
Department of Energy	
Assessment of radioactive waste contamination at a former Soviet naval nuclear submarine training facility at Paldiski in Estonia	250,000
Development of technology on a cooperative basis with the Russians for radioactive waste cleanup	4,606,000
Purchase of Plutonium-238 isotope with proceeds to be partly used to rehabilitate the radioactively contaminated areas of the Chelyabinsk plutonium production facility	11,800,000
Research on radiation's effects at the Chelyabinsk production facility	98,000
Subtotal	**$25,900,000**
Environmental Protection Agency	
Design study to upgrade and expand a low-level liquid radioactive waste-processing facility	$260,000
Department of State	
Extra budgetary contribution to the International Atomic Energy Agency for radiation protection activities in the former Soviet Union	300,000
Support for EPA study	30,000
Nuclear Regulatory Commission	
Assistance to Russian and Ukrainian regulating bodies in developing programs to govern the use of radioactive materials	383,000
Subtotal	**$973,000**
Total	**$26,873,000**

Note 1: Expenditures rounded to thousands of dollars.

Note 2: This table does not include expenditures for U.S. assistance to improve methods of safeguarding nuclear materials at facilities in the former Soviet Union.

Source: Compiled from data from DOD, DOE, NRC, State Department, and EPA.

Status of U.S. Programs Related to Nuclear Facilities in the Former Soviet Union (Other Than Civil Nuclear Power Plants)

Department of Defense

Arctic Contamination

Public Law 102-396 directed DOD to spend not less than $10 million to study, assess, and identify the disposal of nuclear waste by the former Soviet Union in the Arctic region. Subsequently, an additional $20 million has been earmarked for this research. DOD and the Office of Naval Research, under the oversight of the Defense Nuclear Agency, are responsible for addressing radioactive waste contamination of the Arctic region. Most of this effort has been devoted to research projects and expeditions in the Arctic seas to obtain water, sediment, and biological samples and tests for radiological contamination. For example, in 1993 five ships collected samples in the eastern Arctic near nuclear dump sites and the estuaries of major rivers and an additional five ships operated in the western Arctic near Alaska. According to a Navy official, the preliminary results of the testing does not indicate a radiation risk in the region of Alaska. DOD is continuing to support projects to monitor and evaluate the risks around the Arctic and North Pacific region from the former Soviet Union's disposal and discharge of nuclear waste materials.

Radiation Effects in Russia and Kazakhstan

Since 1992, DOD's Armed Forces Radiobiology Research Institute has focused on several projects dealing with radioactive contamination in the former Soviet Union. The Institute's mission is to conduct research in the field of radiobiology and related matters. The Institute has, among other things, (1) studied the long-term medical effects of radiation releases into Russia's Techa River, (2) investigated the consequences of nuclear tests at Kazakhstan's Semipalatinsk test site, and (3) developed documentaries on the radiation conditions at Krasnoyarsk and at the area where the Russian nuclear-powered and armed submarine, Komsomolets, sank in 1989.

Department of Energy

Waste Technology Cooperation

DOE and countries of the former Soviet Union are jointly conducting activities to develop technology in the areas of environmental restoration and waste management. Among other things, DOE seeks to (1) identify and access former Soviet Union technologies and technical information

available at key former Soviet Union institutes that could help accelerate U.S. cleanup of nuclear waste and (2) increase U.S. and former Soviet Union opportunities in the private sector for environmental restoration and waste management. Key areas of interest for the United States are vitrification, waste separation technologies, and migration patterns of radioactive contamination. Program activities are arranged among DOE, its laboratories, and Russian and Ukrainian institutes. According to a DOE official, although the program is still in its early stages, some Russian technologies look promising.

Radiation Health Study

In January 1994, the United States and Russia signed a bilateral agreement to support joint cooperative research and the exchange of information on the health and environmental effects of radiation. A Joint Coordination Committee for Radiation Effects Research was established and DOE is the lead agency for the U.S. government. The first major research focuses on identifying the cumulative effects of radiation on workers and the population around the Chelyabinsk-65 region. To date, joint working groups have been established and workshops and seminars have been held both in Russia and the United States. The United States plans to send research teams into Russia in the latter part of 1995 to begin joint research activities with Russian scientists.

Nuclear Contamination in Estonia

In July 1994, the President of the United States issued a statement committing DOE to participate in a program of technical cooperation with the Republic of Estonia. The United States, as part of an international effort, is helping Estonia evaluate the environmental impacts of a former Soviet naval training facility at Paldiski. This facility houses two nuclear training reactors, one 70 megawatt and one 90 megawatt. The fuel from both reactors has been removed and transported back to Russia. DOE is assisting with several projects, including a decommissioning plan, an overall site characterization study, and training. All technological cooperation projects involve Estonian personnel, who will receive training so they can participate in all phases of the projects. In March 1995, a U.S. team of officials from DOE, Sandia National Laboratory, and Los Alamos National Laboratory made a site visit to describe the extent of contamination and prepare a plan for follow-on actions. According to a DOE official, the Paldiski project may benefit the U.S. cleanup program through its evaluation of new remediation technologies.

Purchase of Plutonium-238

In December 1992, DOE agreed to purchase up to 40 kilograms of plutonium-238 from Russia for civilian space power applications. As of March 31, 1995, DOE had purchased approximately 9 kilograms at a cost of approximately $11.8 million. Russia agreed to use the hard currency received from the sale to remediate the environment and rehabilitate workers and citizens in the Chelyabinsk region. In August 1994, DOE received a detailed accounting from Russia concerning how the funds were distributed from the sale of the first shipment, which totaled about $5.9 million. Of this amount, 38 percent (or $2.2 million) was paid as a federal profit tax. Twenty-five percent (or $918,000) of the remainder was transferred to the Chelyabinsk region's budget to cover unspecified legislated social needs. The balance, less a banker's commission fee, went as follows: approximately $2.6 million for improvements to waste storage and about $158,000 to support a health center, medical rehabilitation, and treatment of workers and citizens near Chelyabinsk-65.

Nuclear Regulatory Commission

Inventorying Radioactive Material in Russia and Ukraine

NRC is providing Russian and Ukrainian personnel with assistance to help establish regulatory controls over radioactive wastes, spent fuels, and materials. For example, assistance is being provided to Russia to help strengthen regulatory programs by providing technical expertise and on-the-job training. NRC believes that such technical exchanges and training help promote safety awareness in these countries and make them better able to improve nuclear safety themselves.

Environmental Protection Agency and State Department

Expanding Russia's Waste Processing Capacity

EPA, with assistance from the State Department, has assessed the feasibility of the conceptual design to expand the waste processing facility operated by the Murmansk Shipping Company. This expansion includes handling the waste associated with decommissioning nuclear submarines. EPA is currently developing the engineering design and the expansion;

upgrading the facility is expected to start in the fall of 1995. According to EPA, the expanded and upgraded processing capacity would provide Russia with an environmentally sound alternative to dumping nuclear waste into the Arctic Ocean. In September 1994, Russia announced that it intends to continue its present policy of voluntary commitment to a recent amendment to the London Convention, which bans the dumping of all other radioactive matter, including low-level radioactive waste into the seas. Russia's waste-processing problems may also contribute to its reduced rate for deactivating and decommissioning nuclear submarines. Currently, over 100 nuclear-powered submarine hulls await final disposition. The initiative to expand the capacity to store nuclear waste is being coordinated with Norway. According to EPA, the program could cost about $3 million if the facility is constructed. The United States and Norway plan to share the cost equally.

Trade and Development Agency

Feasibility Studies to Facilitate Closure of Russia's Production Reactors

In December 1994, the U.S. Trade and Development Agency (TDA) signed two grants for feasibility studies on options to replace the power and steam that will be lost as a result of the shutdown of the three plutonium production reactors at Tomsk-7 and Krasnoyarsk-26. Under the terms of a June 1994 protocol signed by the Vice President of the United States and the Prime Minister of Russia, these three operating reactors should be shut down no later than the year 2000. After initially awarding a grant of $850,000 to Tomsk authorities to evaluate coal and natural gas as alternative fuels, TDA has increased the grant to $1,060,000 to ensure a broader assessment. In March 1995, the Tomsk authorities selected a U.S. firm to perform the study. TDA also provided a $780,000 grant to the municipality of Krasnoyarsk-26 to primarily evaluate the feasibility of two options involving coal as the alternative fuel. In June 1995, the same U.S. firm was selected to undertake the study. Both studies began in August 1995.

Scope and Methodology

To determine the number of nuclear facilities in the countries of the former Soviet Union, we developed an inventory from several publicly available documents. We obtained data from the Monterey Institute of International Studies (Monterey, California), the Natural Resources Defense Council, the International Atomic Energy Agency (Vienna, Austria), and various U.S. government agencies. In most instances, the nuclear facilities were listed in more than one source. Additionally, we sought to corroborate the information through discussions with officials from U.S., international, and private organizations. We met with or obtained information from officials from the former Soviet Union. For example, we had discussions and obtained information from key Russian representatives from Gosatomnadzor (GAN), the regulatory agency, and the Ministry of Atomic Energy (MINATOM). We also met with an official from Russia's Permanent Mission to the International Organizations in Vienna, Austria. Information pertaining to research reactors in the former Soviet Union was obtained from the Kurchatov Institute of Atomic Energy, which is Russia's leading research and development institution in the field of nuclear energy. We discussed the condition of Kazakhstan's nuclear facilities with the Deputy Director of Kazakhstan's Institute for Strategic Studies. We also reviewed pertinent information about facilities in countries of the former Soviet Union that had been prepared in response to an international forum on nuclear safety sponsored by the International Atomic Energy Agency.

To address facility safety and environmental issues, we reviewed available public information and had discussions with nuclear safety experts primarily from the Department of Energy, several national laboratories, and nuclear weapons facilities. We met with or had discussions with numerous officials who had recently visited facilities at Tomsk and Krasnoyarsk. In addition, many of these same officials had participated in workshops on noncivil nuclear power reactor safety with their Russian counterparts. Specifically, we had discussions with officials from the following DOE national laboratories: Los Alamos (Los Alamos, New Mexico), Sandia (Albuquerque, New Mexico), Idaho National Engineering Laboratory (Idaho Falls, Idaho), and Lawrence Livermore Laboratory (Livermore, California). We also had discussions with officials from DOE's Savannah River Site (Aiken, South Carolina) as well as officials from the Pacific Northwest Laboratory (Richland, Washington), who had developed considerable information about Russia's plutonium production reactors and problems with environmental waste contamination. We reviewed available documentation, including trip reports, prepared by DOE and national laboratory officials who had recently visited Russian facilities.

To determine the amount and type of assistance being planned or provided, we obtained pertinent data from various U.S. government agencies that have been providing assistance or are knowledgeable about assistance to the former Soviet Union. Specifically, we obtained data from the following U.S. departments and agencies: Department of Defense's Office of Naval Research, Department of Energy, Department of State, Environmental Protection Agency, Trade and Development Agency, and the Nuclear Regulatory Commission. We did not independently verify the accuracy of the data provided by these agencies.

We discussed nuclear safety assistance issues with representatives from several international organizations and foreign governments. We met with officials at IAEA, the European Union (in Brussels, Belgium), and the Organization for Cooperation and Development's (OECD) Nuclear Energy Agency (in Paris, France). Several IAEA officials had recently visited eight former Soviet Union republics and had been to various facilities in the past 2 years, including Tomsk. We attended a May 1995 workshop at the IAEA on nuclear waste issues in Russia and discussed assistance efforts with representatives from Sweden, Norway, Finland, and Japan. We reviewed various databases to identify international safety assistance, including OECD's Center for Cooperation and Economies in Transition database as well as data from the G-24 Nuclear Safety Assistance Coordination Center in Brussels, Belgium.

Comments From the Nuclear Regulatory Commission

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 24, 1995

Mr. Victor Rezendes
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Rezendes:

We have reviewed the GAO draft report Nuclear Safety: Concerns With Nuclear Facilities and Other Sources of Radiation in the Former Soviet Union, as requested in your letter of August 9, 1995. The following comments are provided and are tied to the pages in the draft report.

General. The report restricts discussion to safety concerns and does not address safeguards concerns. One of our concerns in the New Independent States is the potential for diversion of nuclear material and the prevention measures in place to deter diversion. Consideration should be given to the inclusion of safeguards concerns for the Russian and Ukrainian nuclear facilities.

General. President Yeltsin's July 26 decree on GAN's regulatory responsibilities and the Ukrainian Parliament passing a Radioactive Waste Management Law on June 30 change the regulatory responsibilities of the Russian and Ukrainian regulatory agencies. It is suggested that GAO review these recent announcements, which tend to reduce the authority of the regulatory agencies, and reassess the section entitled Observations.

Page 5. The first paragraph states, "Ukraine has a large concentration of nuclear facilities, including the only operating uranium conversion and enrichment facilities outside of Russia." We are not aware of any enrichment facilities in Ukraine.

Page 21. The chart has the NRC depicted as contributing 2.7% or $1,465,000 of the overall financial effort in this area. There has been some changes to the programs involved and a revised rounded figure of $1,355,000 is provided. This number is derived from the following programs:

$300,000	Russia 9: Licensing and Inspection of Radioactive Materials
$481,459	Ukraine 9: Waste, Spent Fuel & Nuclear Materials
$192,000	Ukraine 15: Regulating Radioactive Sources Utilized in Industry and Medicine
$382,000	Ukraine 16: Transportation of Radioactive Materials

Victor Rezendes - 2 -

Page 22. Suggest the last bullet on the page be revised to read, "assisting Russian and Ukrainian authorities in establishing regulatory control over radioactive materials including the fuel cycle, industrial and medical uses of radioisotopes, and disposal of radioactive wastes."

Sincerely,

James L. Blaha
Assistant for Operations
Office of the Executive Director
for Operations

The following are GAO's comments on NRC's letter dated August 24, 1995.

1. While we recognize that safeguarding nuclear material is an important issue, our report focused primarily on the operational safety of nuclear facilities in countries of the former Soviet Union. Operational safety of nuclear facilities and safeguarding materials are generally considered distinct activities. We plan to discuss issues pertaining to U.S. assistance to improve nuclear material controls at facilities in the former Soviet Union in a forthcoming GAO report.

2. NRC commented that we should review a July 1995 Russian presidential decree that changed the responsibilities of the Russian nuclear regulatory agency. In response, we contacted the Acting Deputy Chairman of Gosatomnadzor (GAN) (the Russian nuclear regulatory agency) who informed us that the Russian President's decree had limited GAN's "sphere of activity" particularly regarding the manufacturing, testing, and use of nuclear weapons. These activities are within the jurisdiction of Russia's Ministry of Defense. He noted, however, that all Russian Ministry of Atomic Energy installations associated with the production of nuclear material are subject to GAN's regulatory oversight. This includes inspection of the operating plutonium production reactors at Tomsk and Krasnoyarsk as well as associated reprocessing facilities. GAN's Acting Deputy Chairman stressed the value of nuclear legislation as a means to improve nuclear safety in Russia.

3. The reference to enrichment facilities in Ukraine has been deleted from our report.

4. The report has been updated to reflect this new information.

5. The report has been changed to reflect this clarification.

Major Contributors to This Report

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

Bernice Steinhardt, Associate Director, Energy and Science Issues
Gene Aloise, Assistant Director
Glen Levis, Assignment Manager
Thomas J. Flaherty, Senior Evaluator/Adviser
Duane G. Fitzgerald, Ph.D., Nuclear Engineer

European Office

Pamela J. Timmerman, Evaluator-in-Charge
Lauren V.A. Waters, Staff Evaluator

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