United States General Accounting Office

GAO

Report to Congressional Requesters

151920

May 1994

NUCLEAR REGULATION

Action Needed to Control Radioactive Contamination at Sewage Treatment Plants

GAO/RCED-94-133

Notice: This is a reprint of a GAO report.

GAO

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

Resources, Community, and
Economic Development Division

B-255099

May 18, 1994

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

The Honorable Mike Synar
Chairman, Environment, Energy, and
Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

The Honorable Louis Stokes
House of Representatives

Radioactive materials are sometimes discharged into municipal sewer systems by facilities such as hospitals, manufacturers, and decontamination laundries that are licensed by the Nuclear Regulatory Commission (NRC). This letter responds to your request that we investigate the radioactive contamination of sewage sludge and the status of cleanup at the Northeast Ohio Regional Sewer District's Southerly Sewage Treatment Plant (Southerly) in Cleveland, Ohio. According to NRC, the most likely source of radioactive contamination was one of its licensees discharging radioactive material into the treatment plant. In addition, because of your concern that such contamination might be more widespread than at the Southerly plant, we agreed to (1) determine whether other sewage treatment plants have been contaminated by radioactive material, (2) identify what NRC and others are doing to limit and monitor the amounts of radioactive materials NRC's licensees discharge that ultimately end up in the sludge and ash (incinerated sludge) of treatment plants, and (3) provide information on NRC's actions to determine whether treatment plant workers and the public are being exposed to radioactively contaminated sludge and ash.

Results in Brief

In April 1991, NRC inadvertently discovered radioactive contamination at the Southerly Sewage Treatment Plant while conducting an aerial radiological survey of one of its licensee's sites. According to NRC officials, the radioactive material (cobalt-60) had concentrated at elevated levels in the plant's sludge and ash. Of the 492 soil samples taken, 133 samples, or 27 percent, exceeded NRC's acceptable level for radiation in soil. After

surveying the treatment plant and the surrounding areas for radiation, NRC concluded that the site poses no health or safety risks to treatment plant workers or to the public because of a variety of factors, such as limited public access to the property. An NRC official told us that the site may need to be monitored for as long as 50 years, if on-site disposal of the contaminated soil is permitted. Southerly officials told us that they have already spent about $1 million for activities related to an on-site cleanup and for a security fence. If NRC or the state of Ohio does not approve on-site disposal of the contaminated soil, the cost of off-site disposal could exceed $3 billion.

The full extent of the radioactive contamination of sewage sludge, ash, and related by-products nationwide is unknown. Neither NRC nor the Environmental Protection Agency (EPA) has conducted or required testing to determine the extent of the radioactive contamination occurring at treatment plants that receive radioactive discharges. Furthermore, NRC has inspected only 15 of the approximately 1,100 NRC licensees that discharge radioactive material to treatment plants to determine if a concentration problem exists. The sewage treatment plants we contacted were generally unaware of the problem of radioactive materials' concentrating in sludge and ash and did not routinely test for radiation.

To address the problem of radioactive materials' concentrating in sludge and ash, NRC has revised its regulation to reduce the concentration of radioactivity that licensees can discharge to treatment plants. However, because of uncertainty about how the radioactive materials concentrate during the sewage treatment process, NRC does not know how effective this action will be. EPA, the agency responsible for regulating certain aspects of treatment plants' operations, does not have authority over NRC licensees' radioactive discharges. Because of the uncertainty about the effectiveness of federal oversight, some local sewer districts are considering actions that impose more stringent limits on the licensees' discharges. However, since neither NRC nor EPA has established acceptable levels for radioactivity in sludge, ash, and related by-products, local authorities are uncertain about how effective their actions would be or if they would be enforceable.

The health implications of the exposure of treatment plant workers and the public to contaminated sludge, ash, and related by-products are unknown because neither NRC nor EPA knows (1) how much radioactive material may be in these products and (2) how these products might affect people. Sewage sludge, ash, and related by-products from treatment

plants' operations are used and disposed of in a variety of ways. Some of the sludge and ash by-products are used for agricultural and residential purposes, as fertilizer for lawns or gardens, for instance. Sludge and ash can also be disposed of on-site at the treatment plant or off-site at a landfill.

Background

NRC issues licenses under the Atomic Energy Act of 1954, as amended, to individuals and entities such as hospitals, research facilities, decontamination laundries, and manufacturers of smoke detectors and other devices and materials. A license permits them to possess, use, and transfer licensed radioactive materials under controlled conditions that limit the public's exposure to radiation. NRC regulates approximately 8,000 licensees in 21 states.[1] NRC also provides the regulatory basis for 29 "agreement" states to regulate approximately 16,000 licensees.[2] NRC has established standards to protect the public health and safety. These standards are intended to minimize the risk of incurring fatal cancers and genetic effects from exposure to radiation. Among other things, these standards, set forth in 10 C.F.R. part 20, set effluent limits that licensees are not to exceed for various radionuclides that NRC is responsible for regulating under the Atomic Energy Act.

NRC and EPA have a regulatory interest in the radioactive materials discharged into sewage treatment plants and the subsequent use and disposal of sewage sludge, ash, and related by-products. NRC is responsible for the low-level radioactive materials discharged by its licensees and for protecting both the workers employed by its licensees and the general public from exposure to these materials. EPA regulates certain aspects of the sewage treatment plants' operations, such as discharges to the plants and to navigable waters, and the disposal of sewage sludge and ash. EPA also has the authority to set generally applicable environmental standards to protect the environment from radioactive materials. The states and localities may impose additional regulations.

[1]NRC-regulated states are Alaska, Connecticut, Delaware, Hawaii, Idaho, Indiana, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Jersey, Ohio, Oklahoma, Pennsylvania, South Dakota, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.

[2]Agreement states are the states that, through agreements with NRC, have assumed the role of NRC in monitoring and regulating the radioactive materials covered under the agreements.

Radioactive Contamination Reported at Several Treatment Plants, but Full Extent of the Problem Is Unknown

Over the last 10 years, at least nine cases have been reported of radioactive contamination at treatment plants resulting from discharges by NRC's and agreement states' licensees into municipal sewage systems. The facilities are located in Cleveland, Ohio; Tonawanda, New York; Grand Island, New York; Oak Ridge, Tennessee; Royersford, Pennsylvania; Erwin, Tennessee; Washington, D.C.; Portland, Oregon; and Ann Arbor, Michigan. With the exception of the Cleveland case, these cases were identified as a result of a state's or NRC's investigations of the licensees and treatment plants.

The full extent of the problem of radionuclides' concentrating at the treatment plants, however, is unknown. EPA and NRC studied this issue in 1986 and 1992, respectively. EPA's study did not provide any conclusions for determining health problems from the reuse and disposal of sewage sludge.[3] NRC's study indicated that some radiation exposure from sewage sludge and ash can occur and suggested that further review is needed.[4] Furthermore, NRC has inspected only 15 of the approximately 1,100 NRC licensees that may discharge radioactive material to treatment plants to determine if a problem exists with concentrations of radioactive materials. An NRC official did not know at the time of our review how many of the estimated 2,000 agreement state licensees may have been inspected. The treatment plants we contacted were generally unaware of the potential problem of radionuclides' concentrating in sludge and ash and did not routinely test these by-products for radiation.

Elevated Levels of Radioactive Contamination Discovered at Northeast Ohio Plant

One of the more recent and significant examples of radioactive contamination at treatment facilities was discovered inadvertently by NRC while conducting an aerial radiological survey of a licensee's site. In April 1991, NRC discovered elevated levels of radiological contamination (cobalt-60) at the Northeast Ohio Regional Sewer District's Southerly plant. According to NRC's documentation, the most likely source of the radioactive material found was an NRC licensee that discharged waste into the sewer lines that are connected to the treatment plant. This material (used in teletherapy equipment as a radiation source for treating cancer patients) subsequently concentrated at elevated levels in the ash that was left over when the plant incinerated its sludge.

[3] Radioactivity of Municipal Sludge, Environmental Protection Agency, Apr. 1986.

[4] Evaluation of Exposure Pathways to Man From Disposal of Radioactive Materials Into Sanitary Sewer Systems, Pacific Northwest Laboratory, May 1992.

After NRC's 1991 aerial radiological survey detected elevated levels of radiation at Southerly, a subsequent preliminary radiation survey by NRC at the plant identified the radiation levels in some soil samples at 20 times the background level.[5] An August 1992 characterization of the site by an NRC contractor showed that elevated concentrations of cobalt-60 were present in samples obtained from all areas surveyed. Of the 492 soil samples taken, 133 samples, or 27 percent, exceeded NRC's acceptable level for radiation in soil. For example, the cobalt-60 concentrations ranged from less than 0.1 to about 31,200 picocuries per gram[6] (pCi/g) for soil samples—a single sample was measured at 3 million pCi/g—and from less than 0.2 to about 75 pCi/g for sediment samples. NRC's criterion for levels that are as low as reasonably achievable[7] and for unrestricted use (no need for future regulatory control by NRC) is 8 pCi/g for cobalt-60. A threat to public health and safety may not always exist if NRC's criterion for unrestricted use is exceeded, but according to a former NRC Commissioner, exceeding the criterion is a public health and safety concern.

NRC officials maintain that the site poses no imminent health or safety risk to the plant's workers or to the public and that removing the contaminated sludge and ash off-site could be costly. A Southerly official said that as of February 1994, the district had spent about $900,000 on site remediation activities and $120,000 to erect a security fence around the contaminated areas to prevent general public access. In addition, NRC spent about $370,000 on a dose assessment, soil samplings and analysis, and radiological site and facility surveys. An NRC official told us that the site may need to be monitored for as long as 50 years if on-site disposal is permitted. However, if NRC or the state of Ohio does not approve on-site disposal of the contaminated soil, the cost of off-site disposal could be about $3 billion, according to Southerly officials. (For more information about the Southerly plant, see app. I.)

[5]The radiation in the natural environment, including cosmic rays and radiation from naturally occurring radioactive elements.

[6]A picocurie is one-trillionth of a curie, which is a measure of the rate of radioactive decay.

[7]As low as reasonably achievable means as low as is reasonably achievable taking into account the state of technology and the economics of improvements in relation to the benefits to the public health and safety, other societal and socioeconomic considerations, and the utilization of atomic energy in the public interest.

Radiation Contamination Discovered at Other Treatment Plants

In addition to the Southerly case, at least eight other cases of radioactive contamination at sewage treatment plants have been reported (see app. II for the details of these cases). The levels of radioactive materials discovered at these plants and the cost to resolve the problem varied significantly.

To determine whether the levels of radiation found at these sites posed a health or safety risk to the public, NRC in 1991 sponsored a study involving five of the eight treatment plants. The study concluded that the levels "may not be trivial" and were high enough to justify further study. According to the Director, Office of Nuclear Material Safety and Safeguards, the study indicated that, in some scenarios, the concentration of radionuclides could produce doses that are substantial fractions of NRC's 100-millirem per year limit on public exposure to radiation.[8] According to information from NRC, for sites at Grand Island, New York, and Oak Ridge, Tennessee, each state required the licensee to reduce its release limits for discharges of the radioactive materials.

The Full Extent of Radioactive Contamination at Treatment Plants Is Unknown

NRC estimated that before January 1, 1994, out of 8,000 NRC-regulated licensees, 1,100 licensees had the potential to discharge into sewers radioactive materials that could concentrate at treatment plants in the 21 NRC-regulated states. NRC periodically inspects its licensees to ensure compliance with the requirements for discharges of radioactive effluents. During the inspections, NRC reviews the licensee's records to ensure that the discharges are in accordance with the authorized limits. The inspections generally do not include a survey of the sewer lines connecting the licensee to a treatment plant or of the treatment plant itself.

For the 29 agreement states, NRC estimated that 2,000 of the 16,000 agreement state licensees discharge radioactive materials into sewers. Inspection of the agreement state licensees is the responsibility of the agreement states and not NRC. An NRC official did not know at the time of our review how many of an estimated 2,000 agreement state licensees that discharge radioactive materials to treatment plants may have been inspected for concentrations of radionuclides.

In November 1984, NRC issued a temporary instruction to regional offices requiring them to inspect certain licensees to determine if a problem existed with radioactive materials' concentrating in sludge at sewage

[8]NRC uses the 100-millirem per year limit as the standard for the maximum amount of radiation exposure allowed per individual that it considers acceptable from a public health perspective. This limit is based on a recommendation by the International Commission on Radiological Protection.

treatment plants; to the extent that a problem was identified, they were instructed to take sludge samples from the treatment plants that received the licensees' discharges. In response to this temporary instruction, NRC inspected 11 licensees and subsequently identified contaminated sludge at two treatment plants—Erwin, Tennessee, and Royersford, Pennsylvania. In addition to the temporary instruction sent to its regional offices, NRC also notified a number of its licensees as well as the radiation program offices in agreement states about the potential for the radioactive materials to concentrate at treatment plants. However, NRC did not require the licensees and the program offices to take any specific actions to address the problem.

The problem of radionuclides' concentrating in sludge and ash continued to get NRC's attention as a result of the states' and NRC's inspections at licensees and treatment plants between 1984 and 1986. Responding to the ongoing concern, NRC issued a second temporary instruction in 1987 and inspected four licensees. NRC identified these licensees because the types and amounts of radionuclides they discharged could concentrate in sewage treatment plants. Included on NRC's 1984 and 1987 lists was a licensee that discharged radionuclides to the Southerly plant. Unlike the 1984 notice that directed NRC's regional staff to take only liquid waste samples from the licensees, this notice specifically directed the staff to take sludge samples from the treatment plants as well. NRC, however, found no significant concentrations of radioactive materials present in the sludge samples from these treatment plants.

NRC has inspected only 15 of the approximately 1,100 NRC licensees that may discharge radioactive material to treatment plants to determine if a concentration problem exists. Furthermore, NRC, despite its two inspections, did not identify the problem with radioactive sludge and ash at Southerly. In 1985, NRC regional officials and a contractor took a sample of sludge from the sewer line of a licensee that was alleged to have discharged excess amounts of cobalt-60 to Southerly. The inspection found some radiation in the licensee's sewer drain, but no tests were made of the sludge or ash at Southerly. In 1987, an NRC inspector was once again sent out to investigate whether the same licensee was contaminating the treatment plant. The inspector obtained dried sludge samples from one of the Northeast Ohio Sewer District's four treatment facilities, but he did not obtain ash samples from the Southerly plant. Ash samples were not taken because the inspector was unfamiliar with Southerly's treatment process or unaware that incineration could concentrate radioactive material in ash.

The treatment plants that we contacted were generally unaware of the potential problem of radioactive materials' concentrating in sludge and ash and did not routinely test these by-products for radiation. NRC did not send its 1984 and 1987 notices about this problem to the treatment plants. We spoke with officials from 21 treatment plants to determine whether they were aware of the potential problem of the concentration of radioactive materials in sludge and ash and whether they tested for radiation. In each of the 21 NRC-regulated states, we selected a treatment plant that, according to NRC officials, is most likely to be receiving low-level radioactive waste from NRC's licensees. We found that only 5 of 21 treatment plants were aware of the problem of radioactive materials concentrating in sludge and ash. In addition, only 5 of the 21 treatment plants have tested for radiation in their sludge and ash, but none are testing on a regular basis, and some had not tested recently. For example, one treatment plant official stated that a one-time test of sludge for radioactive materials was conducted about a year ago. On the basis of the results of this one test, the official stated that it would be a good idea to test the treatment plant's sludge for radiation.

We also contacted two national associations that represent sewer district and treatment plant officials to determine if NRC had notified them about the problem. The director of the Association of Metropolitan Sewerage Agencies, which represents about 150 members with at least 400 treatment plants, was not aware of any NRC notification to the association about the problem of radioactive materials' concentrating at treatment plants. Similarly, we were told by the director of Public Affairs for the Water Environment Federation, which represents some 40,000 members who are typically chief engineers from smaller treatment plants, that his association was also not notified by NRC about the problem.

Radioactive Materials at Treatment Facilities May Not Be Adequately Regulated

NRC and EPA have a regulatory interest in the discharges of radioactive materials to treatment plants and the radioactive materials' subsequent disposal. NRC has taken regulatory action to limit the amount of radioactivity that its licensees can discharge to treatment plants, but it does not know how effective this action will be. EPA is the agency most knowledgeable and closely associated with treatment plants, but EPA does not directly regulate the NRC licensees' discharges of regulated radioactive materials into sewage treatment plants.[9] EPA regulates the treatment

[9]EPA does have the authority to establish generally applicable environmental standards for these materials but has not exercised this authority in the context addressed by this report. EPA may also regulate naturally occurring radioactive materials, such as radium, under the Clean Water Act and the Resource Conservation and Recovery Act.

plants' discharges to navigable waters and any discharges to a treatment plant that may pass through or interfere with the treatment system. EPA also regulates the disposal of sewage sludge and ash.

The full extent of radioactive contamination in sewage sludge, ash, and related by-products nationwide is unknown. Neither NRC nor EPA has required widespread testing to determine the extent of the radioactive contamination occurring at treatment plants receiving radioactive discharges from the NRC licensees and agreement state licensees. As a result, no assurance exists that other treatment plants are not experiencing problems with radioactive materials' concentration. To address the potential problem, some local sewer districts are considering actions that impose more stringent limits on the licensees' discharges. However, without further guidance from NRC and EPA on what levels of radiation are acceptable in sludge and ash, they do not know if their actions will be effective or enforceable.

Impact of Regulatory Actions to Limit Radioactive Discharges From Licensees Is Unknown

While both NRC and EPA can affect the discharges into sewage plants, only NRC regulates its licensees' radioactive discharges into sewers served by treatment plants. In 1991, NRC revised its regulation 10 C.F.R. part 20.303, which controls its licensees' discharges to sewer systems. The revised regulation 10 C.F.R. part 20.2003, which became effective for all licensees on January 1, 1994, limits certain types of licensees' discharges and reduces the concentration levels of the radioactive materials that can be discharged into a sewer system. For example, insoluble discharges, such as the form of cobalt-60 that was found at the Southerly plant, will no longer be allowed for NRC licensees because these discharges concentrate in sludge and ash.

Under NRC's former regulation, 10 C.F.R. part 20.303, which governed licensees' discharges of radioactive materials, NRC permitted its licensees to discharge small quantities of radioactive materials into treatment plants. The discharges had to be made within certain specified limits, provided that the materials were "readily soluble or dispersible in water." NRC assumed that the radioactive materials discharged into a sewer system would remain in solution or would readily disperse in the large volumes of water discharged by the treatment plants and would become almost undetectable. NRC further assumed that the radioactive materials would pass through the treatment facilities' systems to streams and rivers and not settle out in the sludge. However, the materials discharged by some licensees that were initially thought to be readily dispersible precipitated

out of the wastewater and concentrated. For example, in the Southerly case the cobalt-60 in oxide form, which was originally thought to be readily dispersible, concentrated during the sludge treatment process and accumulated in higher concentrations after it was incinerated.

NRC's current regulation reduces the concentrations of radioactive materials that can be discharged compared to what was allowed under the previous regulation, but it retained the 1-curie per year limit for radioactive discharges. For example, NRC's licensees now have to reduce the concentrations in their discharges containing americium-241 and uranium-235 by a factor of 300 over what was required by the former regulation. The concentrations of cesium-137 discharges have to be reduced by a factor of 40, while the concentrations of cobalt-60 discharges have to be reduced by a factor of 30. NRC officials believe that the reductions will address much of the problem of concentration but may not solve it entirely, because even soluble materials that are allowed to be discharged could still concentrate as the result of chemical changes that could occur during the wastewater treatment process. NRC officials were unable to determine to what extent this kind of concentration may occur.

Recognizing that the current regulation could fall short of fully addressing the problem, NRC in September 1993 contracted for a study to examine the impact of the current regulation on preventing the recurrence of significant incidents of concentration. NRC officials informed us that the study would not require any testing at treatment plants but would rely on the existing data from prior case studies of contamination at treatment plants. If it is determined that additional control measures are needed, NRC will examine the possible strategies for changing its current requirements for discharges to sewers. The study is scheduled to be completed in September 1994. NRC also issued an advance notice of proposed rulemaking on February 25, 1994, seeking information to determine whether its regulations governing the release of radionuclides from licensed nuclear facilities to sanitary sewer systems may need to be further amended.

EPA is responsible for administering the National Pretreatment Program under the Federal Water Pollution Control Act, commonly called the Clean Water Act. Industrial dischargers must comply with the national pretreatment standards that limit their discharges to sewage treatment plants in order to protect receiving waters, treatment plant workers, the plant, and sewage sludge from pollutants. The states and treatment plants may further restrict discharges to treatment plants in order to meet local

objectives. EPA also regulates the disposal and use of sewage sludge under this act. Ash is regulated under the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. However, according to EPA's Principal Deputy General Counsel, EPA has no authority under the Clean Water Act or RCRA to directly regulate those radioactive materials covered under the Atomic Energy Act. He noted that it has been the agency's long-standing position, affirmed by the U.S. Supreme Court, that EPA has no authority under the Clean Water Act to regulate the radioactive materials subject to the Atomic Energy Act.[10] The Resource Conservation and Recovery Act also specifically exempts these types of materials.

Agencies Have Not Required Widespread Testing at Sewage Treatment Plants

Neither NRC nor EPA requires treatment plants receiving radioactive discharges from NRC's licensees to test for radioactive materials in their sludge and ash. NRC has the authority to promulgate rules and issue such orders as it may deem necessary to protect the public health and safety from regulated radioactive materials. According to NRC's Deputy General Counsel for Licensing and Regulation, this authority may be applied to unlicensed persons or entities, such as a treatment plant, if necessary to protect the health or safety of the public. However, generally NRC would not issue an order to require testing at a treatment plant unless some prior evidence of a problem existed.

EPA's Principal Deputy General Counsel informed us that EPA does not have the authority to directly regulate the concentration of radioactive materials subject to the Atomic Energy Act that may be found in treatment plants' sewage sludge and ash. The official also informed us that EPA does have the authority under the Atomic Energy Act of 1954, as amended, and the Reorganization Plan No. 3 of 1970 to establish generally applicable environmental standards for the protection of the general environment from radioactive materials. However, EPA has not determined whether this authority would allow it to conduct testing at those treatment plants most likely to be affected by the discharges from NRC's licensees.

Even though, according to EPA's Principal Deputy General Counsel, EPA does not have the authority to directly regulate the concentration of radioactive materials subject to the Atomic Energy Act, EPA does have the authority to regulate air emissions from incinerated sewage sludge that may contain radionuclides. Radionuclides are included on the list of hazardous air pollutants under the Clean Air Act. According to the Director of EPA's Criteria and Standards Division, Office of Radiation and

[10]Train v. Colorado Public Interest Research Group, 426 U.S. 1 (1976).

Indoor Air, EPA could determine if sewage treatment plant incinerators need to be regulated for radioactive emissions on the basis of the reported cases of radioactive contamination of sludge and ash at treatment plants. In addition, EPA is required under the Clean Air Act to issue National Emissions Standards for Hazardous Air Pollutants for treatment plants no later than November 15, 1995. According to EPA's Principal Deputy General Counsel, the measures required to control the emissions of hazardous air pollutants from treatment plants may indirectly affect the concentrations of radionuclides in sewage sludge and ash.

Although EPA officials have not concluded that the radioactive contamination at treatment plants poses a serious health or safety problem, they informed us that they would be willing to work with NRC to assess the extent to which it is a problem. NRC and EPA discuss matters of mutual concern at a senior level on an ongoing basis. The framework for this coordination was formulated under a memorandum of understanding signed on March 16, 1992.

As a result of the number of reported incidents of radioactive materials' concentrating at treatment plants and concerns about potential liability, some localities are attempting to address the problem on their own (see app. III). However, these localities still need guidance from NRC and EPA on what level of radiation in sludge and ash is acceptable and on their authority to regulate radioactive materials.

Treatment Plant Workers and the Public May Be Exposed to Radioactive Sludge and Ash, but Health Impact Is Unknown

Since treatment plant workers and the public may come in contact with radioactively contaminated sewage sludge and ash and related by-products, they may be exposed to radiation. However, the threat to public health and safety is unknown because studies conducted to determine the impact on workers and the public of radioactive materials in sewage sludge and ash have been inconclusive.

Sewage sludge, ash, and related by-products from treatment plants' operations are used and disposed of in a variety of ways. Some of the sludge and ash by-products are used for agricultural and residential purposes, as fertilizer for lawns or gardens, for instance. Sludge and ash can also be disposed of on-site at the treatment plant or off-site at a landfill. For example, discussions with officials from the 21 treatment plants indicated that many disposed of sludge and ash off-site, in some cases using more than one disposal method. Thirteen treatment plants used a public landfill to dispose of their sludge and ash. Seven treatment

plants disposed of at least some of their sludge for agricultural purposes. Two treatment plants sold sludge to landscapers, nurseries, or retail stores as compost. One treatment plant used ash as a surface material on baseball diamonds because it absorbs water well. Another treatment plant is exploring the possibility of using ash to make bricks and blocks or to pave streets.

The health implications for treatment plant workers and the public are unknown because studies conducted to determine the impact of radioactive materials in sewage sludge and ash on workers and the public have been inconclusive. For example, NRC's 1992 study concluded that the radiation levels at some treatment plants, while not an immediate health and safety risk, were not trivial and required further study. A 1986 EPA survey of the radioactivity in sewage sludge, on the other hand, merely documented instances of radioactive contamination in treatment plants' sludge and did not come to any conclusion.

On the basis of a 1986 review by NRC's Region I of eight licensees that discharged to sewage treatment plants, the chief of the region's Nuclear Materials Safety and Safeguards Branch recommended that NRC conduct a nationwide review of the concentrations of radioactive materials at treatment plants. His concern was that the public could be exposed to radioactive materials through sewage sludge applied to farmlands or to private lawns and gardens. This official suggested to NRC headquarters that the review focus on all decontamination laundries and any other licensees of NRC or agreement states whose discharges could result in radioactive materials' concentrating at a treatment plant.

The treatment plants that have experienced incidents of radioactive contamination have attempted to assess the possible health effects on the workers exposed to the concentrated radioactive materials in sludge and ash. For example, when Southerly officials became aware of the elevated levels of cobalt-60 in the plant's sludge and ash, they had the workers with the greatest exposure risk tested for radiation. Eleven workers received whole-body radiation counts to detect the presence of cobalt-60. Although none of the workers were found to have detectable levels of cobalt-60, a Southerly official told us that it may not be possible to guarantee that no damage was done. The body naturally rids itself of cobalt-60 in a relatively short amount of time, and tests cannot be done for prior exposure to radiation. In addition, an NRC senior radiation specialist, who was present when the workers were tested, stated that cobalt-60 has a half-life of about 5 years, and NRC believes that the exposure of the Southerly workers

occurred about 10 years ago. Therefore, the whole-body counts performed on the workers likely would not show any signs of cobalt-60 exposure.

Conclusions

While several cases of radioactive contamination have occurred at sewage treatment plants, the full extent of this contamination nationwide is unknown. In addition, some treatment plants may use and dispose of their sludge and ash in a variety of ways that could expose plant workers and the general public to elevated levels of radioactivity. Although NRC believes that no imminent health risk exists for the treatment plant workers and the general public, on the basis of NRC's 1992 report on radioactive materials' concentrating at five sewage treatment plants, both NRC and EPA officials agreed that further study is needed. Furthermore, where elevated levels of radiation have been detected in sludge and ash, the treatment plants are faced with concerns about the disposal and/or monitoring of the contaminated material and the prospect of incurring future cleanup costs.

The problem of radioactive contamination of sludge and ash in the reported cases was the result, in large part, of NRC's regulation, which was incorrectly based on the assumption that radioactive materials would flow through treatment systems and not concentrate. NRC officials do not know why the radionuclides are being filtered out, and NRC has sponsored a study to determine the impact that its revised regulation will have on limiting the concentration of radioactive materials in sludge and ash. If it is determined that additional measures are needed, NRC will examine possible strategies for changing its current sewage disposal requirements. Until the study is completed, treatment plant officials may need more information about the concentration problem so that they can take whatever action they deem appropriate. The treatment plants and local sewer district officials have requested guidance from NRC and EPA on what levels of radiation are acceptable in their sludge and ash and on their authority to regulate radioactive materials.

Given that NRC is responsible for minimizing the exposure of the general public to radiation and that EPA could establish generally acceptable environmental standards for ensuring that sludge, ash, and related by-products do not harm the environment, both agencies have an interest in addressing the problem of radioactive contamination at treatment plants. It is important for the federal government to take prompt and necessary actions to assure the public that the sludge and ash by-products that they may come in contact with are free from harmful levels of radiation. Even though NRC has issued an advance notice of proposed

rulemaking on the problem of radionuclides' concentrating at some treatment plants, the treatment plants receiving radioactive materials from NRC's licensees may still not be aware of the problem. Since the concentration of radionuclides is of interest to EPA, EPA officials told us that they would be willing to assist NRC in identifying the treatment plants receiving radioactive materials from NRC's licensees and offered EPA's expertise on treatment plants' operations.

Recommendations

To determine what actions may be needed to better control the spread of radioactively contaminated sludge, ash, and related by-products from sewage treatment plants that receive radioactive materials from NRC's licensees, we recommend that the Chairman, NRC,

- determine the extent to which radioactive contamination of sewage sludge, ash, and related by-products is occurring;
- directly notify the treatment plants that receive discharges from NRC's and the agreement states' licensees of the potential for radioactive contamination because of radioactive materials' concentrating and of the possibility that they may need to test or monitor their sludge for radioactive content; and
- establish acceptable limits for radioactivity in sludge, ash, and related by-products that should not be exceeded in order to ensure the health and safety of treatment workers and the public.

Agency Comments

We discussed the facts presented in this report with the Deputy Executive Director for Nuclear Materials Safety, Safeguards, and Operations Support and other NRC officials at headquarters, and the Director, Criteria and Standards Division, Office of Radiation and Indoor Air, and other officials at EPA headquarters. Both NRC and EPA officials generally agreed with the facts in this report but offered some technical clarifications that were incorporated where appropriate. Because of NRC's five reported cases of radioactive materials' concentrating at treatment plants, both NRC and EPA agreed that further study is needed to determine the potential risk to public health and safety. As requested, we did not obtain written agency comments on this report. We conducted our review from August 1993 through February 1994 in accordance with generally accepted government auditing standards. Appendix IV contains more information on our scope and methodology.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to appropriate congressional committees; the Chairman of the Nuclear Regulatory Commission; the Administrator, Environmental Protection Agency; and the Director, Office of Management and Budget.

We will also make copies available to others upon request. This report was prepared under the direction of Victor S. Rezendes, Director, Energy and Science Issues, who may be reached at (202) 512-3841. Other major contributors to this report are listed in appendix V.

Keith O. Fultz
Assistant Comptroller General

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Figure I.1: Southerly Sewage Treatment Plant—Areas of Elevated Levels of Radiation 21

Abbreviations

EPA	Environmental Protection Agency
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
pCi/g	picocuries per gram
RCRA	Resource Conservation and Recovery Act
uR/hr	microroentgens per hour

Summary of the Northeast Ohio Regional Sewer District's Southerly Sewage Treatment Plant

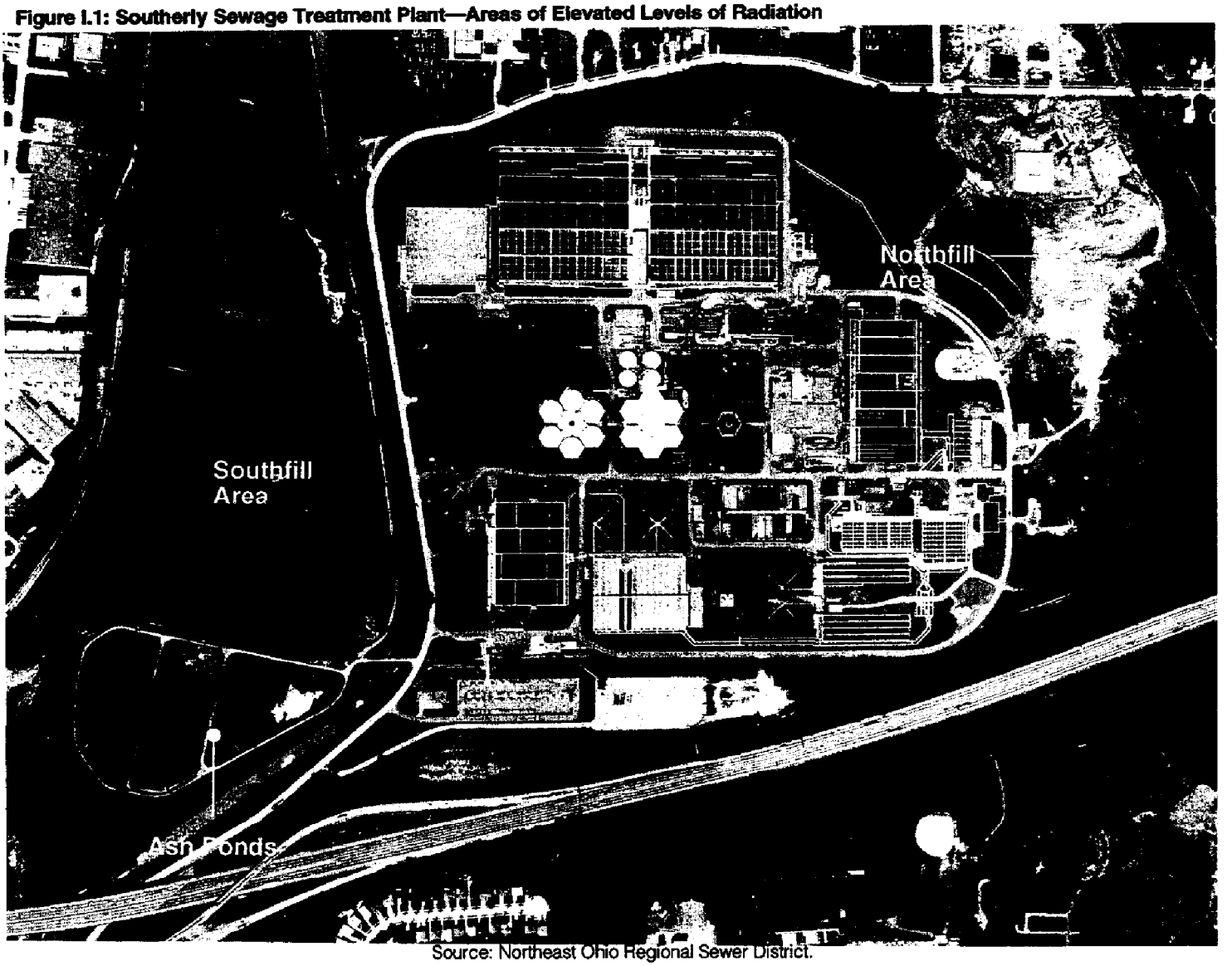
In 1972, the district was established as a regional sewer district in Ohio. At that time, the district assumed control over the Easterly, Southerly, and Westerly sewage treatment plants; the sludge force main; the interceptor sewers flowing into the plants; and all land, facilities, equipment, and working capital that were part of Cleveland, Ohio's sewage treatment and disposal system. Today, the district owns and operates four sewage treatment plants (Easterly, Southerly, Strongville, and Westerly). The four plants serve 52 suburban communities and the city of Cleveland.

The Southerly plant uses a primary and secondary process to treat sewage. The plant can completely treat up to 175 million gallons of wastewater per day during dry weather. In 1992, Southerly treated an average of 121.2 million gallons of wastewater per day, processed about 103,000 wet tons of filter cake, incinerated about 97,000 wet tons, and hauled about 5,200 wet tons off-site. The Southerly plant employs 225 persons and serves over 500,000 residents. It is one of the largest activated sludge treatment plants in the nation.

The Southerly plant receives all of the sludge generated by the district's sewage treatment plants with the exception of the Westerly plant's sludge. After the sludge is incinerated, the ash is pumped in slurry form into three settlement/evaporation ponds (referred to as the A, B, and C ponds). The ponds reach capacity in about 3 years, at which time the ash has to be removed and placed in various on-site locations as fill. Southerly officials told us that none of the ash has ever been taken off-site for disposal. The sludge that is not incinerated is transported off-site to private landfills. Southerly uses several companies to haul its sludge off-site. The companies are required to use district-approved landfills.

An aerial radiological survey conducted in April 1991 over Newburgh Heights, Ohio, detected elevated levels of radiation at the Southerly plant (see fig. I.1). The survey was done at the request of the Nuclear Regulatory Commission (NRC) to measure the radiation in the environment around the former Chemetron (an NRC licensee) manufacturing plant and the surrounding disposal site. The survey results showed the evidence of radioactive material in the form of cobalt-60.

Figure I.1: Southerly Sewage Treatment Plant—Areas of Elevated Levels of Radiation



Source: Northeast Ohio Regional Sewer District.

According to NRC's documentation, the most likely source of the radioactive material found was an NRC licensee that discharged waste into the sewer lines that are connected to the treatment plant. NRC inspected the manufacturer's radioactive liquid waste disposal into the sanitary sewer, including a review of the disposal records, and concluded that the disposal did not exceed NRC's allowable limits. The manufacturer's records

documented that a total of about .2 curies of cobalt-60 was discharged into the sanitary sewers from May 1980 to May 1989.

On May 15, 1991, an NRC radiation specialist and two Ohio Department of Health officials visited the Southerly plant to conduct radiation surveys to confirm the location of the ground contamination. The officials used radiation detectors to locate the ground contamination, and both NRC and state officials collected soil samples for subsequent analysis. The officials primarily found elevated radioactive readings around the northeast and southeast sections of the Southerly property. According to the NRC inspection report, the northeast section of the property was previously a marsh and had been filled with ash from the ponds some time in the late 1970s or early 1980s. The southeast section of the property included the three settling ponds.

The background readings from both sections of the property were about 10-12 microroentgens per hour (uR/hr). The radiation readings around the northeast section were at about 20 times the background level. No radiation levels were above background at any of the three settling ponds. The highest radiation levels in the northeast section were found in animal dens. Radiation readings up to 200 uR/hr were obtained when a detection instrument was placed just below the ground surface in several dens. Two samples collected from the dens and an eroded bank measured 27 to 79 picocuries per gram (pCi/g) for cobalt-60, 0.59 to 1.29 pCi/g for radium-226, and 0.13 to 0.14 pCi/g for cesium-137. According to NRC, the concentrations of radium-226 and cesium-137 were in the normal range of naturally occurring and fallout radioactivity found in soil. The only area exhibiting elevated radioactive readings at the southeast section of the property was associated with fill (about 8 feet thick) located in a diked area near two of the settling ponds. The maximum reading was about 30 uR/hr. No soil samples were collected from the southeast section. At this time, the district received verbal notice from NRC that it suspected some very-low-level radiation contamination was present at Southerly.

On June 19, 1991, NRC confirmed its suspicion in the form of a written "preliminary notification" that cobalt-60 contamination was indeed present at Southerly. On August 27, 1991, an NRC inspector and an Ohio Department of Health inspector surveyed the district's Easterly plant for possible cobalt-60 contamination because sludge from the manufacturer of the radioactive sources first goes to the Easterly plant before it is pumped to Southerly for incineration. The results of the survey were negative. All measured radiation levels in and around the Easterly plant were within

normal radiation background levels of the immediate area, except inside the plant. Inside the plant, radiation levels were as high as 45 uR/hr and were attributable to building materials which were believed to have contained small quantities of naturally occurring uranium and thorium and their associated decay products.

NRC contracted with Oak Ridge Associated Universities to perform a detailed assessment of the Southerly plant site. This included developing a comprehensive characterization of the radioactive contamination and appropriate recommendations for remediation of the site. The university conducted a radiological characterization survey of selected outdoor areas at the Southerly plant during the periods September 16-25, 1991, and March 16-26, 1992. The university surveyed an area totaling over 168,000 square meters (approximately the size of 32 football fields) around Southerly's fill areas, sanitary ponds, steam plant, and a storage tank. The survey identified 111 locations with elevated levels of direct radiation ranging from 15 to 580 uR/hr in an area of about 9,200 square meters (about the size of 2 football fields).

NRC is using an 8-pCi/g criterion for cobalt-60 to release the areas for unrestricted use. The maximum concentration found in a surface soil sample was 3 million pCi/g, and it was obtained from the pond area. However, the university did not consider this sample to be representative of the soil concentrations present. The maximum concentration in subsurface samples taken from depths of about 1/2 foot to 11 feet was 31,200 pCi/g for the south fill area. According to NRC, while the survey indicated the presence of cobalt-60 contamination in various concentrations, there was no indication of significant radiation exposure to the public because of the isolated and secured location of the contamination. In August 1992, the university issued its final report on the survey.

Although district, state, and NRC officials agree that the contamination around Southerly does not pose a public health threat, an estimate as to the amount of cobalt-60 that entered the plant is not expected until early June 1994. According to NRC, this information is needed to determine, among other things, how much radiation the plant workers were exposed to when the material passed through the plant.

On April 15, 1992, in an attempt to measure the approximate amount of radioactive materials either inhaled or ingested into the body, 11 district employees participated in whole-body radiation measurements at the

Perry Nuclear Power Plant. On the basis of interviews with management, a union steward, and the employees themselves, eight employees were originally chosen as having the highest risk of exposure because they were involved in some way with the incinerated ash. Later, the district added three employees to the group to be examined. None of the employees examined showed detectable levels of radiation.

According to information provided by district officials to its employees, any detectable radioactive materials in the employees may have already disappeared. Within 2 to 3 years following the inhalation or ingestion of cobalt-60, the body will have eliminated the great majority of the material. Moreover, cobalt-60 decays at the rate of 1/2 times the total cobalt present in about 5 years. Finally, with the combination of the body's ability to eliminate cobalt-60 and the rapid decay of cobalt-60, an NRC senior radiation specialist said that it is very unlikely that a whole-body radiation measurement will yield any useful information about what may have happened years ago.

The district plans to perform its own study that would be more representative of the actual pattern of exposure that its employees received. Initially, NRC planned to conduct this study, but after the district reviewed the scope of NRC's proposed survey, the district decided to fund its own more comprehensive study and analysis. On April 8, 1993, the Mayor of Cleveland requested that NRC provide a written opinion as to whether the activities conducted by the manufacturer did at any time, past or present, pose any risk to the public health and welfare of the citizens of the city of Cleveland. On May 24-28, 1993, NRC conducted a survey of the neighborhood near the manufacturer's facility. NRC employees, accompanied by district, state, and local officials, completed a comprehensive radiological survey in and around the facility. As part of this survey, they checked the grounds of Mark Tromba Park, located on Mandalay Avenue near the facility, including a baseball field, a playground, and a swimming pool. No cobalt-60 was found in any of the soil samples in the public areas. NRC held a public meeting on May 28, 1993, to discuss the survey results and respond to any public concerns.

At the request of the Mayor of Cuyahoga Heights, Ohio, NRC and the Cuyahoga County Board of Health on June 24-25, 1993, conducted a special inspection to assess radiation levels and ensure that no radioactive materials had migrated off-site from the Southerly plant into nearby residential areas. The inspection included eight residential yards along East 49th Street and all of the front yards of the homes along Willowbrook

Drive in Cuyahoga Heights. The inspection showed that no radiation levels above normal ambient background levels were identified and that no radioactive materials had migrated from the Southerly plant into these areas. The results were discussed with the Mayor of Cuyahoga Heights on July 7, 1993.

District officials told us that they thought the universities' initial site characterization work would be adequate for remediation purposes. However, because the site characterization was not as comprehensive as originally thought for remediation purposes, the district in May 1992 hired its own consultant to finish the site characterization and develop a remediation plan. District officials believe that the universities' site characterization would probably have been more cost-effective if it had been more comprehensive. Instead, the district had to mobilize its staff twice to help with site characterizations.

The district hired a consultant to provide professional services for the completion of the site characterization, pond(s) excavation, preparation of a site characterization report, and submittal of a site remediation plan.[1] Efforts to identify the source of contamination and to develop instrumentation to prevent the future contamination of the district's waste treatment plants are also included in the contract. The total estimated cost to clean and secure the site will be about $1.2 million. As of mid-February 1994, the district has spent about $0.9 million on site remediation activities and $120,000 to erect a fence around the north and south fill areas and the holding ponds to prevent public access. In January 1993, the district installed thermoluminescent dosimeters at strategic locations throughout all four treatment plants and the pump stations. According to a Southerly official, the thermoluminescent dosimeters have been read quarterly since January 1993 and have not detected any radioactivity above background levels. Also, the district plans to get recommendations for installing survey equipment that will alert plant personnel when radioactive material enters the plant.

The district's consultant submitted project schedules to NRC on December 30, 1992, for pond excavation and on January 11, 1993, for a site operations and radiological control plan. The project schedules and the site operations and radiological control plan were reviewed by NRC and its comments submitted to the district on January 15 and February 19, 1993, respectively. The district submitted its site characterization plan to NRC on

[1]The remediation plan includes the methods the district intends to use to dispose of the contamination and ensure protection of workers and the environment against radiation hazards during the remediation.

April 23, 1993. From June to September 1993, material from the three ponds was removed to the south fill area. The cleaning of the ponds was necessary because they were expected to reach their capacity in July 1993. NRC staff accelerated their reviews of the district's proposals so that the ponds could be placed in service without affecting the plant's operation. Pond C was placed in operation on July 5, 1993. Ponds A and B were placed in operation around October 1993.

As part of the remediation, about 174,000 cubic yards of contaminated ash from the ponds were moved to the south fill area, and about 6 inches of soil was placed over the material. Seven monitoring wells were also installed in the same area. The area where the material was moved covers between 1 and 2 acres. The district does not want to move the contaminated material from the north fill area because it does not want to take a risk of getting the material airborne, spreading it, and further exposing the workers.

The district does not expect any problems with its plan to leave the contaminated material on site. The district plans to propose to NRC that any contaminated ash removed from the ponds be combined with existing contaminated ash in the south fill area and stored in place pending completion of its final remediation plan. A district official told us that the remediation plan will not be submitted to NRC until late June 1994. NRC and state officials need to review the plan to determine if on-site disposal is acceptable. Both NRC and state of Ohio officials agree that leaving the material on-site is probably the most practical disposal option. District officials told us that disposal of the material off-site could cost at least $3 billion.

According to the district, NRC has consistently taken the position that unless it can prove the manufacturer exceeded the discharge limits set forth in 10 C.F.R. part 20.303, there is no action NRC can take against the manufacturer. NRC maintains that the district is responsible for any and all costs associated with the remediation of the site since the district is in possession of the contamination.

District officials believe that passing on the costs of the cleanup to its rate payers is unfair, and they are taking action to keep this from happening. The district filed a petition (pursuant to 10 C.F.R. part 2.206) on March 3, 1993, requesting that NRC modify the manufacturer's NRC license to require it to (1) assume all costs resulting from the release of cobalt-60 that has been deposited at the Southerly plant and (2) decontaminate the sewer

connecting the manufacturer's facility with the public sewer and continue decontamination of the sewers downstream as far as necessary. The district filed another petition with NRC dated August 2, 1993 (pursuant to 10 C.F.R. part 2.206) requesting that NRC institute a proceeding to modify the manufacturer's NRC license to require the manufacturer to provide adequate financial assurance to cover public liability pursuant to section 170 of the Atomic Energy Act of 1954, as amended. According to the NRC, it is taking appropriate actions on the two petitions as separate matters. In April 1993, the district filed a lawsuit against the manufacturer for damages to its Southerly plant from the cobalt-60 released into the district's sanitary sewers.

The district's August 2, 1993, petition, noted above, raised another issue separate from its request for action against the manufacturer. It also requested at least 24 hours' advance notification to the district from the NRC licensees in its service areas before they release radioactive materials into the district's sanitary sewer. The district submitted another petition on August 2, 1993. That petition for rulemaking requested that the NRC amend its regulations to (1) require that all licensees provide at least 24 hours' advance notice to the appropriate sewage treatment plant before releasing radioactive material to the sanitary system and (2) exempt materials that enter the sanitary waste stream from the requirements for NRC's approval for incineration under NRC's current regulations. NRC issued an advance notice of proposed rulemaking on February 25, 1994, seeking information to determine the need for an amendment of its regulations governing the release of radionuclides from licensed nuclear facilities to sanitary sewer systems. Comments on the petition will be considered under this rulemaking.

Reported Cases of Radioactive Contamination at Sewage Treatment Plants

Sewage treatment plant's location	Date found	Radionuclides found	Summary
Tonawanda, New York (agreement state)	1983	Americium-241	The state of New York has paid $2.5 million for cleaning up the treatment plant and sewer lines. The Tonawanda landfill needs to be cleaned up; the estimated cost is $7 million.
Grand Island, New York (agreement state)	1984	Americium-241, hydrogen-3, polonium-210	No cleanup was required at the treatment plant.
Oak Ridge, Tennessee (agreement state)	1984	Cesium-134, cesium-137, cobalt-60, manganese-54	No cleanup was required at the treatment plant.
Royersford, Pennsylvania	1985	Manganese-54, cobalt-58, cobalt-60, strontium-89, zinc-66, plus 11 other radionuclides	No cleanup was required at the treatment plant.
Erwin, Tennessee (agreement state)	1986	Americium-241, plutonium-239, thorium-232, uranium-234, 235, and 238	One of the treatment plant's "sludge digesters" needs to be cleaned up; the estimated cost is $250,000.
Washington, D.C.	1986	Carbon-14, hydrogen-3, phosphorus-32 and 33, sodium-22, sulfur-35, plus 21 other radionuclides	No cleanup was required at the treatment plant.
Portland, Oregon (agreement state)	1989	Thorium-232	Licensee paid about $2 million for cleaning up the sewer lines and installing a pretreatment system.
Ann Arbor, Michigan	1991	Cobalt-60, manganese-54, silver-108m and 110m, zinc-65	No cleanup was required at the treatment plant.
Cleveland, Ohio[a]	1991	Cobalt-60	The district has spent about $900,000 for site remediation activities and $120,000 for a fence to prevent public access. Disposal of the material off-site could exceed $3 billion.

[a]The sewage treatment plant is located in the Village of Cuyahoga Heights, south of Cleveland.

Sources: NRC Office of Nuclear Material Safety and Safeguards Report, Dose Assessment for Disposal of Radiologically Contaminated Sludge at Two Landfill Sites: The Johnson City, TN, and the Carter County/Elizabethton, TN, April 1993; Oak Ridge Institute for Science and Education Report, Radiological Characterization Survey for Selected Outdoor Areas Northeast Ohio Regional Sewer District Southerly Wastewater Treatment Plant Cleveland, Ohio, August 1992; Pacific Northwest Laboratory Report, Evaluation of Exposure Pathways to Man From Disposal of Radioactive Materials Into Sanitary Sewer Systems, May 1992; EG&G Energy Measurements Report, An Aerial Radiological Survey of the Former Chemetron Factory Site and Surrounding Area, Newburgh Heights, Ohio, September 1991; and GAO's interviews with NRC Office of Nuclear Regulatory Research and sewage treatment plant officials.

Localities Addressing the Radioactive Material Concentration Problem

The Metropolitan St. Louis Sewer District passed an ordinance in August 1991 that limits the aggregate discharge of radioactive materials into the sewage system. District officials were concerned about the potential hazard to treatment plant workers and to the general public if radioactive materials are concentrating in the sewer system. When the ordinance is enforced, all of the NRC licensees in the district can discharge only a combined total of 1 curie of radioactive material in 1 year, whereas NRC permits each licensee to discharge up to 1 curie per year. District officials believe that more guidance and regulations are needed from NRC and the Environmental Protection Agency on what levels of radiation in sludge are permissible and how to best address the problem if it occurs.

In Portland, Oregon, the state's health division and the city ordered a state licensee to install a pretreatment system to control the discharge of thorium oxide in sewer lines. The city's sewer workers now have to wear protective clothing when they work in the sewers where thorium oxide-bearing sediments exist. State and local officials had considered enforcement actions to completely stop the discharges by this licensee. However, the City of Portland was concerned about a lack of clear, scientifically based standards addressing the discharge and the resulting accumulation of thorium oxide in the sewers. Without a clear, defensible standard, the city was uncertain whether it could require the licensee to eliminate its thorium oxide discharges, which the licensee estimated would cost $5 million.

The Royersford, Pennsylvania, treatment plant is having problems disposing of its radioactive sewage. According to the plant supervisor, processed sludge from the plant, which contains small quantities of radioactive materials, has been spread in a marsh area within the facility's grounds. Reeds growing in the marsh have absorbed much of the radioactive materials from the sludge. The facility intended to either mulch the reeds and dispose of the solid waste in a public landfill or burn the reeds. NRC did not object to either disposal method because, in the agency's opinion, the radioactive level of the reeds was below regulatory concern. However, the state environmental protection agency, which has the regulatory responsibility for solid waste disposal and air quality standards, has not approved of these disposal options because of concerns that the environment could be adversely affected. Without any agreement between the two agencies as to what disposal method is acceptable, the plant supervisor stated that the facility may have to store the reeds on-site for 30 years.

The city of Laramie, Wyoming, is exploring the implications of privatizing its sewage treatment system. The city is concerned about its possible liability for the disposal of sludge that might contain radioactive materials. To obtain information on these issues, the city asked NRC in a September 1993 letter for its views on the legality of imposing a municipal regulation that regulates or prohibits the discharge of radioactive materials. Specifically, the city wanted to know if such action would be preempted by the Atomic Energy Act. NRC's Deputy General Counsel for Licensing and Regulation informed the city of Laramie that, in general, if the city were to have sound reasons, other than radiation protection, to require the pretreatment of wastes to eliminate or reduce radioactivity, such pretreatment would not run afoul of the Atomic Energy Act. He further stated that the NRC regulations that allow users of regulated materials to discharge to treatment plants do not compel a sewage treatment operator to accept these radioactive materials. However, a city official indicated that this NRC guidance was too vague and did not answer the question of whether a municipality or a treatment plant could lawfully regulate or prohibit a licensee's discharge of radioactive materials into its sewage treatment system.

Scope and Methodology

To determine the extent to which treatment plants were having problems with radioactive sludge and ash, we examined NRC's, EPA's, and the states' studies of the occurrences of radioactive contamination at treatment plants. We discussed treatment plant problems with NRC, EPA, and treatment plant association officials. We selected a treatment plant in each of the 21 NRC-regulated states, which according to NRC officials is most likely to be receiving low-level radioactive waste from NRC's licensees, to determine whether they (1) were aware of the concentration issue, (2) had experienced any problems with radioactive materials concentrating in their sludge or ash, and (3) had tested their sludge or ash for radioactive materials. We also conducted a detailed review of the Southerly treatment plant in northeast Ohio, where NRC recently discovered elevated levels of radioactive contamination. As part of this effort, we visited the site to observe the extent of the contamination and cleanup activities.

To determine the extent to which treatment plant workers and the public may be exposed to radioactively contaminated sludge and ash and the extent of the related health implications, we reviewed the Pacific Northwest Laboratory's study sponsored by NRC to determine the possible health effects that radiological contaminated sludge and ash could have on treatment plant workers. We also spoke with treatment plant officials and reviewed documents to obtain information on what actions were undertaken to assess the health risk to treatment plant workers. We also reviewed NRC's and the treatments plants' documents to determine the results of the analyses to assess the health risks to treatment plant workers. In addition, we reviewed state information and spoke with treatment plant officials to determine the potential uses for sludge and ash by-products.

To determine what actions NRC and EPA have taken and could take to limit and monitor the amounts of radiation discharged into sewer systems by licensees, we reviewed the Atomic Energy Act of 1954, as amended, the Reorganization Plan No. 3 of 1970, the Energy Reorganization Act of 1974, and the Clean Water Act to determine NRC's and EPA's authority and responsibility for regulating radioactive materials in sewage systems. We also obtained information from NRC's and EPA's Office of General Counsel and reviewed NRC's February 25, 1994, advance notice of proposed rulemaking on the NRC licensees' disposal of radioactive material by release into sanitary sewer systems. At NRC, we met with various staff members, including the Director of NRC's Office of Nuclear Material Safety and Safeguards, and the Director of NRC's Office of Regulatory Research to

determine what actions have been taken to limit licensees' discharges in the past.

At EPA, we met with the Director and staff, Criteria and Standards Division, Office of Radiation and Indoor Air; the Acting Director and staff, Office of Science and Technology; the Director and staff, Health and Ecological Criteria Division; staff from the Office of General Counsel; staff from the Office of Wastewater Enforcement and Compliance; and staff from the Office of Water, Sludge Risk Assessment Branch, to determine EPA's responsibilities for regulating radioactive materials in sewage systems.

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