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1993

Site Environmental Report Summary

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1993

Site Environmental Report Summary

By now, counting calories, applying sunscreen, and exercising may have become a way of life for you. Because you value your health, you try to monitor and control the things that affect it. There are times though, that you rely on others to provide information concerning your health. For example, many of you with seasonal allergies rely on the daily pollen count provided by the weather service to determine your outdoor activities. Likewise, many of you in the area rely on us to provide information about how site activities may affect the community. Since 1959, we have published an annual environmental report to meet the requirements of the Department of Energy (**DOE**), the Ohio Environmental Protection Agency (**OEPA**), and the United States Environmental Protection Agency (**USEPA**). This pamphlet contains information relevant to your health as well as the safety of the environment. Our environmental monitoring activities measure and estimate the amount of radioactive and nonradioactive materials that may leave the site and enter the surrounding environment.

This pamphlet summarizes the **1993 Site Environmental Report (SER)**, and describes for you the Fernald site mission, exposure pathways, and environmental standards and guidelines. This presents an overall view of the impact these activities have on the local environment and public health. For many, this summary will contain enough information, but for those who would like to know more about a particular topic, we have included page references to the SER in the margins. The SER is available at:

Public Environmental Information Center
10845 Hamilton-Cleves Road
Harrison, OH 45030
(513) 738-0164

The Fernald Site

In May 1951, ground was broken on a 1,050 acre area just north of Fernald, Ohio for a new facility to produce uranium metal in support of defence activities. This small farming community lies 17 miles northwest of downtown Cincinnati, Ohio. In October 1951, the first uranium derby was produced at the site's Pilot Plant, and by 1954

a major portion of the construction was completed. The Fernald site was established in the early 1950s primarily to produce uranium metal but has since shifted its mission to waste management and environmental remediation.

During the 1950s and the 1960s the Cold War put uranium-metal production at its peak. Funding for production and related activities, including environmental monitoring, was reduced significantly in the 1970s. In the early 1980s, production quickly accelerated with defense spending; by the late 1980s demand dropped again, and finally in July 1989, production was suspended. The Office of Environmental Restoration and Waste Management took over responsibility for the plant from the Defense programs in October 1990. In February 1991, DOE formally announced its intention to permanently end production and submitted a closure plan to Congress which became effective in June 1991.

Radiation

Because we store and handle radioactive materials onsite, we think it is important for you to understand the possible health hazards associated with these materials. Radioactivity is the process by which the nucleus of an unstable atom spontaneously disintegrates. When an atom decays, energy released as particles or waves is called radiation. The term "radiation" can refer to such things as heat, sound, or visible light. Radiation can occur naturally, in the form of cosmic radiation from space, from naturally occurring radioactive materials in soil, and from naturally occurring radioactive elements in food and air. Besides natural sources of radiation, man-made sources, such as medical X-rays, televisions, building materials, and smoke detectors, are part of our everyday life. The first chart on the next page shows the sources and amounts of radiation we are exposed to annually.

Radiation exists here at Fernald in alpha particles, beta particles, and gamma rays emitted from substances such as uranium and thorium. Not all radioactive materials emit all three types of radiation, and each kind can be stopped by different materials. The second chart shows the penetration ability of these three types of radiation.

Percentage of an Average American's Annual Dose

Types of Radiation

Radiation is measured in units of rem; the more rem, the higher the potential damage. We often use a millirem (mrem), equal to 1/1000 of a rem, for measurement because the amount of background radiation and radiation from the Fernald site is so low.

Concerns have been raised as to why well water with low concentrations of natural uranium is safe for some household uses but is unsafe for drinking or cooking. This may appear inconsistent and cause misunderstanding. Human skin acts as a barrier against alpha particles; therefore, there is no danger in using the water for washing or bathing. It is also safe for watering plants. But inside your body there are no dead cell layers to protect your live organ cells from alpha particles, making it unsafe to use the water for drinking or cooking.

Environmental Monitoring

For more information on exposure pathways, see page 22 in the Site Environmental Report.

Environmental monitoring investigates the effects that past and current Fernald site operations have on the environment. Environmental monitoring focuses on the **air** and **liquid pathways**, which are routes pollutants travel from Fernald to the surrounding community. The air pathway includes pollutants carried from the site through the air and direct radiation. The liquid pathway includes all the pollutants that could travel offsite suspended or dissolved in a liquid. Our **Environmental Monitoring Program** is designed to:

- detect unusual release of materials so corrective actions can be taken,
- monitor releases to ensure standards and guidelines are not exceeded,
- evaluate past and present effects on the environment,
- estimate dose from past operations and current clean-up, and
- measure progress of correcting problems.

General Air and Liquid Pathways to Humans

Air Pathway Monitoring

For more information on sampling the air pathway, see pages 67 through 71 in the Site Environmental Report.

There are two main steps in monitoring the air pathway for radioactive contaminants. First, we measure the emission rate of contamination from the waste pit area and the plant stacks. This provides preliminary information on how much contamination is released and how it will act in the environment. Second, we measure the concentration of pollutants in the air onsite and at the fenceline. Weather conditions affect how the pollutants are distributed into the environment. We have 20 Air Monitoring Stations (AMS) located onsite, near the fenceline, and at several locations in nearby communities. The AMSs are used to collect airborne contaminants during the specified sampling period. Each AMS operates 24 hours a day, 7 days a week. The filters are exchanged weekly and a solution is created from each filter to be analyzed. Contaminant emissions dropped substantially since production activities were stopped in

1989. In 1993, uranium emissions were estimated to be 0.46 pound, the lowest in the history of the site. However, a future increase in emissions is possible as contaminated buildings and equipment are torn down.

Range of Total Uranium Occurring In Surface Soils

Soil Sampling – By evaluating soil samples taken at air monitoring stations, we can determine if Fernald site operations have had effects on uranium concentrations in the soil. Uranium found in the soil may be naturally occurring or from Fernald activities. As shown in the graph to the left, the naturally occurring uranium content in soil ranged from 1.5 to 4.4 pCi/g throughout Ohio.

There are no DOE or USEPA standards for uranium levels in soil, but 35 pCi/g or higher is recognized as a level to begin the clean-up process. The samples taken at different onsite and fence line locations ranged from 1.8 to 18 pCi/g. The higher amounts of uranium were found in the northeastern section of the site. The uranium is higher in this area due to airborne emissions and deposits during uranium production. Except for the northeast section, the amount of uranium in the soil is within the range of naturally occurring concentrations in Ohio soil.

Grass Sampling – Grass may become contaminated by absorbing uranium in the soil or from deposits on the surface of the plant from the air. Generally, plants do not absorb uranium since it does not have any purpose in their metabolic process. Through a plant's normal growth process, however, small amounts could be absorbed. We collected grass samples at the same locations as the soil samples. When we compared the uranium concentrations, the onsite and fence line location samples were higher than the offsite samples. Standards have not been set for uranium levels in grass; however, comparisons of onsite and offsite grass samples provide a way to evaluate the effect of uranium concentrations in grass.

Produce Sampling – The Fernald site is surrounded by farmland, where local residents grow and sell produce. With air emissions reduced since the end of production, the possibility of uranium contamination in produce is very low. However, some uranium may be absorbed through the roots. Uranium detected in produce may be naturally occurring, added by fertilizers, or deposited from airborne emissions. We sample produce yearly to determine if uranium concentrations in produce grown near the site (0–3 miles) are higher than in those grown distant from the site (7–26 miles). In general, uranium concentrations varied for each produce type. In corn and tomatoes, the average concentrations were higher in those grown distant from the site. The average concentrations were consistent with previous years for all types of produce. These comparisons suggest that there are currently no effects from Fernald site emissions on produce.

Milk Sampling – Even though uranium is not normally concentrated in milk, we monitor cows' milk because of public concerns about the dairy farm located next to the site. In 1993, we collected monthly samples from the neighboring dairy farm, as well as milk from an Indiana dairy 23 miles west of Fernald. The results of these samples showed that the average uranium concentrations at the Indiana dairy were comparable to the concentrations at the local dairy. A test for radionuclides also showed that concentrations in milk from the local dairy are similar to concentrations at the Indiana dairy. The results suggest that site emissions do not affect the local dairy's milk.

Direct Radiation Monitoring – Direct radiation originates from sources such as cosmic radiation, naturally occurring radionuclides in soil, world wide fallout, and radioactive materials such as those at the Fernald site. The largest source of direct radiation at the site is the material stored in the K-65 silos. Direct radiation levels are measured at 29 locations at the site with thermoluminescent dosimeters (TLD).

When direct radiation comes in contact with the TLD, the energy is stored. We then collect the TLDs containing the stored energy and heat them, causing the energy to be released so we can measure it. The levels of radiation are higher in the area near the K-65 silos than anywhere else on site. However, since the addition of the bentonite layer in 1991, the level of direct radiation has been clearly lower.

Radon Sampling – In addition to monitoring direct radiation, we also monitor radon. Radon is a radioactive gas that occurs naturally throughout the environment and comprises the majority of the annual background radiation dose that you receive. We store materials onsite that decay to form additional radon. Radon is a gas present in the atmosphere, and when inhaled may cause damage to your lungs. The K-65 silos are the primary source of radon at the site. The average fence-line radon concentration in 1993 was 0.63 ± 0.20 pCi/L. This is considerably less than DOE limit of 3.0 pCi/L.

Nonradioactive Pollutants Monitoring – The Clean Air Act requires us to test for sulfur dioxide, nitrogen oxide, and carbon monoxide. We also measure the shade or density of particle emissions from the coal-fired boilers, which is a measure of how many particles are present in stack emissions. In order to estimate sulfur dioxide emissions, we regularly determine the sulfur content of the coal. For 1993, sulfur dioxide emissions were calculated to be 630,000 pounds. This is well below the allowable limit of 3.5 million pounds. Nitrogen oxide emissions for 1993 were estimated to be 336,000 pounds. Carbon monoxide emissions in 1993 were estimated to be 120,000 pounds. However, nitrogen oxide and carbon monoxide concentration limits have not yet been established for the Boiler Plant. These emissions were estimated to be 36,000 pounds for 1993. Boiler Plant emissions were higher in 1993 than in 1992 because we returned the boilers to full service after a coal bunker fire in 1992 limited Boiler Plant operation.

Liquid Pathway Monitoring

Here at the Fernald site we also investigate the effects of past and current activities on the **liquid pathway**. Since contaminants can leave the site through the regulated liquid effluents and uncontrolled stormwater runoff, we monitor the Great Miami River and Paddys Run.

LIQUID EFFLUENT

Liquid waste material usually containing low levels of contamination that is discharged into the environment.

Effluent Sampling – We control site-generated liquid effluents, monitor them, and treat them as necessary before they combine to form a single liquid effluent that is discharged to the Great Miami River.

Total Uranium Discharged from the Site

In 1993, Manhole-176B carried all controlled effluents to the Great Miami River. Samples were collected continuously and gathered every 24 hours to provide daily contaminant concentrations. A total of 1,044 pounds of uranium was discharged last year to the river, 7% more than 1992. However, the uranium contained in all liquid effluents discharged from the site decreased from 1,309 pounds in 1992 to 1,283 pounds in 1993 as shown in the chart to the left. This decrease may be attributed to the completion of the Waste Pit Area Stormwater Runoff project that collects runoff, allowing it to be treated before being discharged to the river. We have estimated that approximately 6.3 pounds of uranium are released as uncontrolled stormwater runoff for every inch of rain. In 1993, it was estimated that 241 pounds of uranium were released to Paddys Run in the uncontrolled stormwater runoff.

For more information on sampling of the liquid pathway, see pages 81 through 115 in the Site Environmental Report.

Surface Water Sampling – Untreated contamination can also reach the environment through stormwater runoff. Most of this runoff is collected in the Stormwater Retention Basin or is treated through the Waste Pit Area Runoff Control Removal Action. During 1993, we sampled surface water at 11 locations along the Great Miami River and Paddys Run. Higher uranium concentrations were found in an outfall ditch that flows into Paddys Run. This ditch has had elevated uranium concentrations in the past as well. Downstream uranium concentrations were higher than upstream, but were well below DOE guidelines for drinking water. These guidelines are used for comparison purposes only.

Sediment Sampling – We monitor sediment in Paddys Run and the Great Miami River since contaminants can settle and accumulate in sediment. In August 1993, we collected 45 sediment samples and analyzed them for uranium, radium-226, and isotopes of thorium. Sediment samples collected from the Great Miami River and Paddys Run showed no noticeable differences in the concentration of uranium and other radionuclides upstream and downstream of the site.

Fish Sampling – Together with a research team from the University of Cincinnati, we have been sampling fish from the Great Miami River for the past 10 years. In August 1993, we collected over 224 fish from three locations along the Great Miami River. Over the course of our study, the uranium concentrations in the fish and the fish population of the Great Miami River have been stable. Nearly all of our testing locations had the same species, and the fish appeared to be in similar health.

Nonradioactive Pollutants – We monitor and control the discharge of nonradioactive pollutants to ensure they meet our National Pollutant Discharge Elimination System permit. Of the 4,020 samples we took from the Great Miami River in 1993, only 11 did not meet drinking water standards. We use these standards for comparison purposes only because no water downstream from the Fernald site is designated as a public source of drinking water.

Groundwater Sampling – Surface water runoff can leach through the soil and possibly contaminate the groundwater. We carefully monitor the area groundwater to identify and track the movement of pollutants present in the Great Miami Aquifer. We also monitor for uranium in groundwater because it is our primary contaminant of concern. By studying the groundwater and soils sampled during drilling operations, our scientists can learn about the soil and its ability to stop the contamination movement into the groundwater. USEPA is responsible for setting standards and guidelines for substances in drinking water lower than the lowest concentration known to cause illness or injury to humans or the environment. National Primary Drinking Water Standards are enforced by federal law.

To protect the Great Miami Aquifer we monitor nonradioactive pollutants and general water quality indicators listed in the National Primary and Secondary Drinking Water Standards. Primary Standards apply to substances that can be health threatening if present beyond regulated amounts. Secondary Standards control contaminants that are not federally enforceable and only affect the look or taste of the drinking water.

PUBLIC WATER SUPPLY PROGRAM

In 1992, the Public Water Supply Program was proposed to protect public health by installing 14 miles of pipeline within Hamilton and Butler counties. The pipeline will be installed along East Miami River Road from Bolton Water Works to the intersection of state routes 126 and 128. It will run south along State Route 128 about 1.7 miles south of the New Haven Road intersection, and also along Willey, New Haven, and Paddys Run roads. Until this project is completed, we are temporarily providing residents whose wells have been impacted by the South Plume with bottled water. This project is scheduled to be completed by mid-1995.

Private Well Sampling – In 1993, we regularly sampled 36 private wells near our site for uranium and other metals. In 31 wells we found uranium concentrations at only 3 ppb or below, which is less than 15% of the proposed USEPA standard for uranium in drinking water. For comparison, local background levels range from 0.1 to 3 ppb. Three wells we sampled had average uranium concentrations above the proposed USEPA standard of 20 ppb. Each was in an area of known groundwater contamination.

Because the area contains high amounts of natural iron and manganese, several wells showed concentrations above USEPA Secondary Drinking Water Standards. We found four wells showing lead concentrations at or above the USEPA action level guideline for lead.

Comprehensive Sampling – The South Groundwater Contamination Plume area is known for high uranium contamination levels flowing with the groundwater toward the Great Miami River. In 1993, because of increased monitoring activities, we detected more uranium than in previous years. After sampling 454 site-owned wells, we found 127 wells in the South Plume area showing uranium amounts above 20 ppb.

We also sampled these 454 wells for 11 metals and 31 Volatile Organic Compounds with applicable Primary Drinking Water Standards. Twenty of the 42 substances we sampled for were above primary standards and 16 were found in more than one well.

Estimated Radiation Doses for 1993

For more information on estimated doses, see pages 117 through 125 in the Site Environmental Report.

DOE Orders and USEPA regulations require us to keep our radionuclide airborne emissions less than 10 mrem per year. Also, to ensure that we are far below the maximum dose of 100 mrem per year from all exposure pathways (excluding radon), we estimate doses from other components of the air and liquid pathways, as well as direct radiation dose from materials stored onsite. These estimations are done specifically for public safety. Computer or environmental models help us to estimate the upper limit of a dose and identify the most influential pollutant or pathway of exposure.

We use *environmental models*, which are mathematical formulas, to help us estimate doses through environmental sampling. Models are often the only way to estimate a dose, but they do not necessarily predict all environmental processes because they are predictions, not actual measurements.

Airborne Emissions -- We estimate airborne emissions with an environmental model called CAP-88. CAP-88 estimated the maximum effective dose from 1993 airborne emissions to be 0.016 mrem to the **maximally-exposed individual (MEI)** located north of the former production area. This is well below the standard of 10 mrem per person per year.

Foodstuffs -- We estimated the 1993 doses from foodstuffs eaten by the MEI to be 0.01 mrem. This means that they only received about 0.01% of the DOE dose limit of

100 mrem per year from foodstuffs. This value is based on a yearly diet of 40 pounds of leafy vegetables, 100 pounds of grains, 150 pounds of fruit, 62 pounds of below-ground vegetables, 100 pounds of other vegetables, and 30 gallons of milk all produced locally.

"MAXIMALLY-EXPOSED" INDIVIDUAL

This is a hypothetical individual who is exposed to all pathways of contamination. This individual only consumes meat, vegetables, and milk produced in the area along with fish and water from the Great Miami River. For airborne emissions we assume that this person remains outside, along the site fenceline 100% of the time. When estimating direct radiation doses we use the dose at the home nearest the K-65 silos.

Direct Radiation Dose -- During 1993 no dose was attributed to the Fernald site because there was no statistical difference between the maximum fenceline dose and the average background dose.

Liquid Pathway Doses -- We use environmental sample results from groundwater and fish from the river to estimate liquid pathway doses. In our area, background groundwater uranium concentrations range from 0.1 to 3.0 ppb. The maximum concentration of uranium in drinking water from a well near the site was 5.9 ppb. This resulted in a dose of 0.7 mrem. This estimate was based on drinking 0.5 gallon of water from this well each day.

Dose to Maximally-Exposed Individual – We estimated that the total annual dose during 1993 to the MEI was approximately 1.0 mrem from all pathways. This dose is similar to that of 1992. In addition, it is well below the DOE guideline of 100 mrem per year for all pathways.

Estimated Dose from Radon – Because radon is regulated separately from other components of the air pathway, the dose attributable to it is also discussed separately from the dose to the MEI. Based on the average fenceline radon concentration of 0.63 pCi/L, the dose was estimated to be 454 mrem. This dose includes the annual dose received from average background levels of radon – approximately 200 mrem per year.

By reading the information provided in this pamphlet we hope you have a better understanding of our programs at the Fernald site. Monitoring and sampling provide us with data concerning your health as well as the safety of the environment. Together, DOE and FERMCO are committed to the safe, least-cost, earliest, final cleanup of the site, within applicable DOE Orders, regulations, and commitments, and in a manner which addresses stakeholder concerns.

As part of its efforts to include the public in its activities, Fernald invited us, the Technical Writing class at Oak Hills High School, to write this summary pamphlet. We would like to thank the people at Fernald, particularly Tim Neyer and Amy Valimont, for the opportunity to not only practice our technical writing skills, but also to learn more about the Fernald Site.

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