Argonne NATIONAL LABORATORY

ANL-13/02 (Summary)

Summary Site Environmental Report

for Calendar Year 2012

Environment, Safety, and Quality Assurance Division

About Argonne National Laboratory

Argonne is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC under contract DE-AC02-06CH11357. The Laboratory's main facility is outside Chicago, at 9700 South Cass Avenue, Argonne, Illinois 60439. For information about Argonne and its pioneering science and technology programs, see www.anl.gov.

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For more information about Argonne and its programs, visit the laboratory's website at www.anl.gov or contact Communications, Education, and Public Affairs, at 630.252.5575.

Katherine Obmascik edited the text. Photos by Mark Lopez. Graphic design by Michele Nelson.

KYLIE TOERPE

A MESSAGE FROM THE STUDENTS

ENVIRONMENTAL SCIENCES STUDENTS FROM DOWNERS GROVE SOUTH HIGH SCHOOL

From left: *Scott D. Howard (teacher), Patti Puszkarski, Dominic Rossi, Kwame Asante-Ababio, Lian Lucansky, Jacob Curry, Kate Troyer (teacher).*

Not pictured: *Ryan Holtrop, Jeremy Pettit, Kylie Toerpe*

Each year, scientists at Argonne National Laboratory (Argonne) conduct studies and collect data to determine and report on the environmental impact of activities at the site. This information is published in the annual *Argonne Site Environmental Report*. As a teaching and learning exercise, high-school students in a science class in the local area are tasked with condensing some of the information into a *Summary Site Environmental Report* that is geared for more general audiences. This summary report contains a brief explanation of what Argonne does to reduce and improve their overall environmental footprint. This booklet also discusses projects Argonne has accomplished or intends to accomplish over the next few years to improve its sustainability. This year, the students of the Downers Grove South High School Biology II course were selected to collaborate with Argonne personnel in writing the Summary.

The Biology II students of Downers Grove South High School, taught by Mrs. Troyer and Mr. Howard, participated in field trips that provided us with background information on many of the topics touched on in this report. Our first trip was to Argonne. We spent our morning of this half-day field trip walking through the grounds and identifying important wetland and prairie plants that we had been assigned to study individually. Then, as a class, we had an opportunity to teach our peers about our individual plants and their importance to the ecosystem.

Students sharing information about prairie plants

Our second field trip was to Lyman Woods in Downers Grove, where we spent our entire day in two particular sections of the property: Lacey Creek and the prairie grounds. We measured different parameter levels in Lacey Creek, such as the turbidity and nitrates, and we identified its inhabitants. In the prairie, we collected more specimen and soil samples. Back in class, we looked at the significance of the species collected as well as the makeup of the soil samples. This gave us background information on the restoration of natural areas, as we identified invasive species as well as the characteristics of ecosystems themselves.

Students examining prairie plants

Those of us selected for this project were then given the task of creating an outline of the *Summary Site Environmental Report*. Based on past reports as well as important ideas that we believed needed to be discussed, we compiled the outline as a team. We then assigned each student a section based on their preference, and we began our project.

At first, the project seemed like a difficult prospect. With minimal background on our sections, we felt the task of providing enough information was monumental, especially in the more difficult areas such as radiological studies. However, thanks to a visit from Mr. Baurac, the Argonne editorial coordinator of the project, and Mr. Moos, the Argonne scientist who coordinated the technical aspects, the task became clearer as we understood better where we could collect the information. We used the official *Argonne Site Environmental Report for Calendar Year 2012*, took the basic elements of each of our sections as well as the important highlights, and used them to create a simpler, condensed version of the official report for this Summary. Their visit encouraged us to use all the credible sources we could gather to improve our understanding of our assigned sections.

Student examining prairie plants

By the end of the project, there was not a student who was not proud of their work and excited about having our names published under the Argonne National Laboratory name. In addition, we were educated on important environmental aspects of the world outside our classroom experiments. We are all very grateful for the opportunity and we would like to thank Argonne for allowing our involvement in this project. We were honored to be presented with the chance to put our best efforts into writing and compiling the information for the *Summary Site Environmental Report for Calendar Year 2012.*

Mr. Howard showing prairie plants to students

PATRYCIA PUSZKARSKI

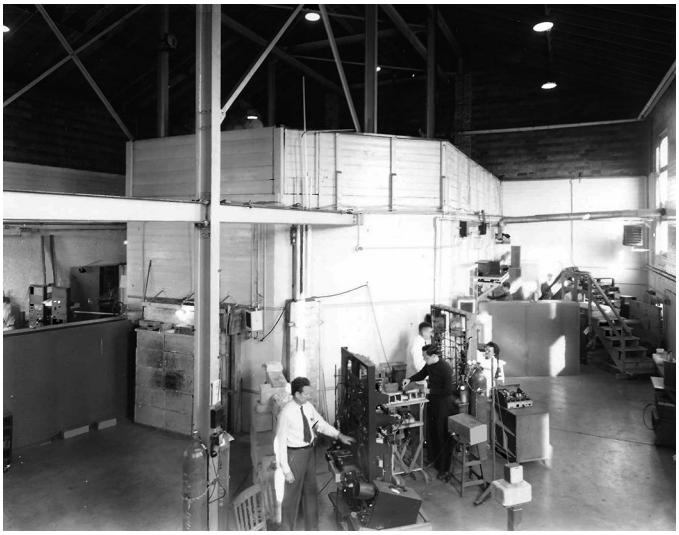
WHAT IS ARGONNE?

Argonne has done much for our community and society, introducing ideas used throughout the world. Argonne is creating new ways to prepare for the future.

HOW IT ALL BEGAN

Before there was ever an Argonne National Laboratory, the site it now occupies was 75 percent plowed field and 25 percent pasture, open forest, and woodlots. The project that sparked all the creativity that goes on at Argonne was the University of Chicago's Metallurgical Laboratory, part of the World War II Manhattan Project. The Met Lab's goal was to produce the world's first self-sustaining nuclear reaction, which was achieved on Dec. 2, 1942. But the Met Lab's leaders needed to find a safer location, away from the city, for all their studies and experiments involving the brand new technology of nuclear reactors. A new laboratory was created to specifically conduct "cooperative research in nucleonics." In 1943, the lab was created in the Argonne Forest section of the Cook County Forest Preserve in Palos Hills, Illinois. Later, in the late 1940s and early 1950s, the laboratory was relocated to its current DuPage County home near Lemont, Illinois. To conduct further nuclear research, a remote location was created in Idaho, which is now Idaho National Laboratory.

There have been many successes at Argonne, including the Chicago Pile 3, the world's first heavy-water moderated reactor and the Experimental Breeder Reactor I, which lit a string of four light bulbs to produce the world's first useful amount of nuclear-generated electricity. Much of the knowledge gained from these early Argonne experiments is still used around the world for electric power generation.



CP-3 Reactor at Argonne National Laboratory

WHAT ARGONNE IS NOW

Today, Argonne is one of the most scientifically influential research centers in the world. Argonne continues to lead the world by supplying scientific and engineering solutions to the imposing challenges of our era: sustainable energy, a healthy environment, and a secure nation.

ARGONNE'S MISSION

Argonne's goal is to operate world-class science, engineering, and user facilities to devise innovative research and technologies. New knowledge is created every day to address the scientific and societal needs of our nation.

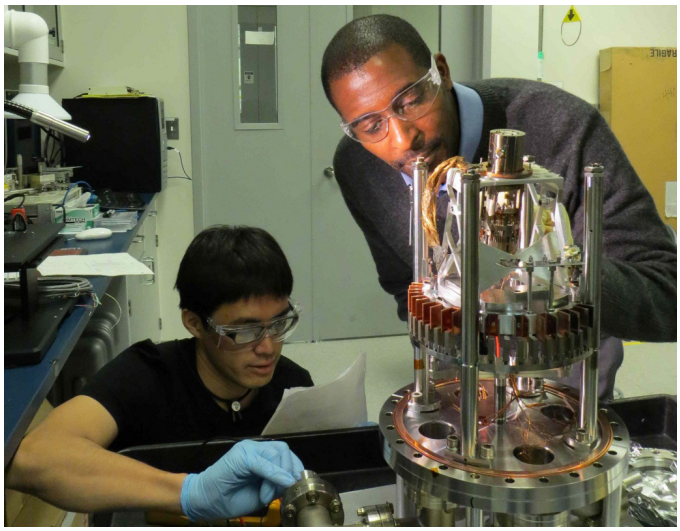
ARGONNE'S IMPACT ON THE WORLD

Argonne's funding of about $794 million a year supports over 200 research projects. Fifteen million dollars of that comes from licensing royalties that were received from new patents and technology licenses.

Argonne directly provides over 4,950 jobs in Illinois. The lab is used by over 5,500 researchers from all over the world. Employees voluntarily donate millions of dollars to local charities. Argonne is very involved in area schools. The scientists from Argonne have worked with over 4,300 elementary, middle, and high-school students from Illinois.

SO WHAT HAPPENS AT ARGONNE?

Argonne employs approximately 3,500 scientists and engineers. Qualities needed to work at Argonne include dedication, a strong work ethic, and the drive to tackle challenging problems.

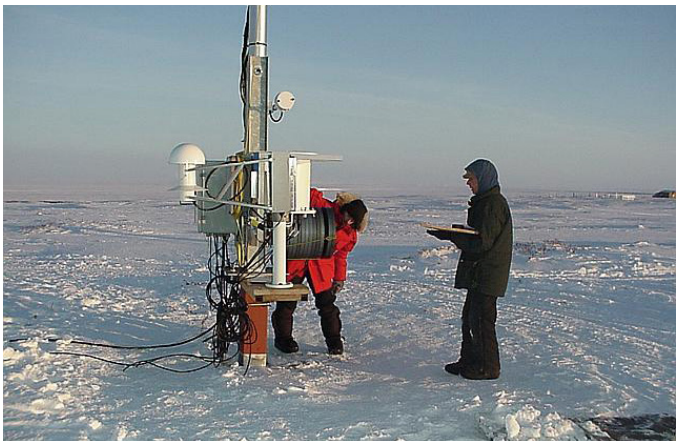


Argonne scientists at the Advanced Photon Source

Argonne jobs give employees the opportunity to show their skills and passion for science. Everyday, Argonne scientists and engineers work hard on over 200 research projects. These projects fall under many different categories. The principal research areas are: Physical, Biological, and Computing Sciences; Photon Sciences; Energy and Environmental Science and Technology; Engineering Research; and Operations.

continued... What is Argonne?

In one important area, scientists are diligently conducting biological and environmental research studies to tackle the causes and effects of climate change. They are also estimating how these changes cause economic, health, and social consequences.



Argonne scientists conducting atmospheric studies in Antarctica

Another research study involves nuclear waste stored in an underground room similar to a tunnel. These "tunnels" are carved into salty material, creating an underground repository. Studies are being undertaken to determine new ways to dispose of nuclear waste and minimize potential leakage.

ABOUT ARGONNE

Argonne is located in DuPage County, about 25 miles southwest of Chicago. The Argonne site includes 1,500 acres of gently rolling land that contains several streams, ponds, and cattail marshes. Weather in this area is typical of the upper Midwest and is moderated by Lake Michigan. The Waterfall Glen Forest Preserve is the nearest neighbor to Argonne. This land is used primarily for recreational purposes. This land was part of Argonne but was given to DuPage County to use for bike riding, hiking, picnics, and other outdoor recreational activities.

Argonne has numerous buildings where research is done. Other buildings house security facilities, fabrication shops, a boiler house, and a wastewater treatment plant. There are even housing areas and a fire station on the campus.

The soil beneath Argonne was created by glacial deposits of clay and sand, which lie above Niagaran and Alexandrian limestone bedrock that are on top of shale and older sandstones of the Ordovician and Cambrian age. To the south of Argonne lie the Des Plaines River and Chicago Sanitary and Ship Canal. The river valley was carved by waters flowing out of Lake Michigan 11,000 to 14,000 years ago. The area is now covered in well-drained soils. The soils are black to dark brown in color, have high organic matter content, and large water capacity.

Aerial photo of Argonne

JEREMY PETTIT

ENVIRONMENTAL MANAGEMENT SYSTEM

Argonne is doing everything it can to improve the environment in the immediate community while conducting research that could improve the overall health of the world's environment. All operations and experiments conducted at Argonne must be environmentally safe and follow any permit conditions. Argonne as a whole is committed to continuous environmental improvement, pollution prevention, waste minimization, and as much recycling as possible.

Environmental Impacts — Argonne oversees all of its operations to identify which aspects of the operations have an impact on the environment and to determine which of those impacts are negative or positive. The Integrated Safety Management System (ISMS) is the U.S. Department of Energy's (DOE) umbrella management system for environment, safety, and health programs and systems. It provides the correct structure to ensure that any work activities that could possibly affect a worker, the public, or the environment are performed in a safe and environmentally friendly way. When certain operations do have an impact on the environment, Argonne uses an Environmental Management System (EMS) to help minimize or eliminate the possible impacts. The EMS uses a scoring method to identify four significant environmental aspects: air emissions, wastewater discharges, waste generation, and pollution prevention and/or waste minimization. These aspects are monitored to determine the possibility of environmental harm and to find ways to reduce Argonne's impact on the environment. Argonne's EMS received its current certificate of registration in May of 2013, after successfully completing an audit in April.

Public Involvement — Whenever there is something new happening at Argonne, it is a priority to inform the public about it. Argonne also identifies where the public believes opportunities for environmental improvements may be possible. Ways of communicating with the public include feedback from public interest groups, the Community Leaders Round Table, the Community Update newsletter, the Argonne OutLoud lecture series (public lectures at Argonne including topics of interest to the community), the *Argonne Now* magazine of science features and news (stories about breakthroughs happening at Argonne), tours of the site, Argonne speakers bureau, and the public website (www.anl.gov), which includes many facts about Argonne.

Argonne's Sustainability — Another way that Argonne tries to improve its environmental performance while conducting experiments and projects is through a set of objectives and targets developed each year to improve its performance. During 2012, 37 objectives and targets were identified. Every single objective was completed on schedule and many exceeded the goal. These goals included conserving electricity; reducing greenhouse gas emissions and energy use; constructing high-performance buildings; improving fleet management; and increasing emphasis on water use efficiency, pollution prevention, and waste reduction. A current project at Argonne is a new and updated combined heat and power plant. This power plant will be used to generate steam used for heating while supplying electricity to site buildings. As a part of the high-performance building's goal, six buildings currently meet the Leadership in Energy and Environmental Design (LEED) criteria (green building certification system). Two of these buildings were under construction and two buildings were being upgraded to meet the LEED criteria. In addition, Argonne is creating a sustainable pathway to the future in fleet management, which includes 16 compact and subcompact sedans, 11 hybrid electric vehicles, and 26 neighborhood vehicles including 13 electric vehicles (as well as charging stations for the electric vehicles), and 13 diesel-fueled tractors. With these vehicles in place, Argonne has been able to lower the number of traditional vehicles to only 119 vehicles for the entire laboratory.

Water Efficiency — Argonne uses two main sources for water: drinking water is supplied by the DuPage Water Commission and industrial water for the building and process cooling comes from the Chicago Sanitary and Ship canal. The amount of water used by Argonne has been reduced by 34% since 2008.

Energy Sciences Building - LEED Gold certified building

continued... Environmental Management System

Recycling and Saving — Argonne makes it a priority to recycle as many waste materials as possible and to prevent as much pollution and solid waste as possible. The Argonne Property Excess System (APES) works with Argonne employees to recycle and reuse extra equipment and supplies. Argonne recycles everything from office paper to scrap metal to batteries and everything in between. In 2012, a total of about $117,716 was saved by these recycling efforts (see Table 1).

TABLE 1 – RECYCLED MATERIALS (2012)	
MATERIAL	AMOUNT RECYCLED (TONS)
Mixed office paper	30
Aluminum (70%), steel (10%), glass (10%), and plastic (10%)	86
Asphalt, concrete, and construction debris	223
Scrap metal	369
Computer components (PCs)	23
Computer monitors	274
Toner cartridges	5.3
Batteries	0.2
Engine lubricating oils	7.9
Fluorescent lightbulbs	0.6
Lead/acid batteries	1.3
Transparencies	0.01

Awards — Argonne received the 2012 Federal Energy and Water Management Award for Better Buildings. Argonne's buildings are constantly being upgraded and improved to reduce energy and water use and to continue down the road to better environmental management. Argonne also received the 2012 DOE Sustainability Award for outstanding sustainability projects and practices. This award was received for developing a new program for middle-school teachers to further expand the outreach to children about current issues in our environment, including global warming, transportation, and the benefits and risks of different energy sources.

Conclusion — Argonne National Laboratory is looked up to all across the United States. With a recycling program saving thousands of dollars a year and a constantly improving environmental management system that is often awarded for its amazing work, Argonne is admired for its advanced management systems.

Argonne electrical vehicle recharging at solar-powered charging station

2012 FEDERAL ENERGY AND WATER MANAGEMENT AWARD PRESENTATION

From left: *FEMP Program Director Tim Unruh, Argonne Architect George Norek, EERE Deputy Assistant Secretary for Energy Efficiency Kathleen Hogan, DOE Sustainability Performance Office Director Jennifer MacDonald*

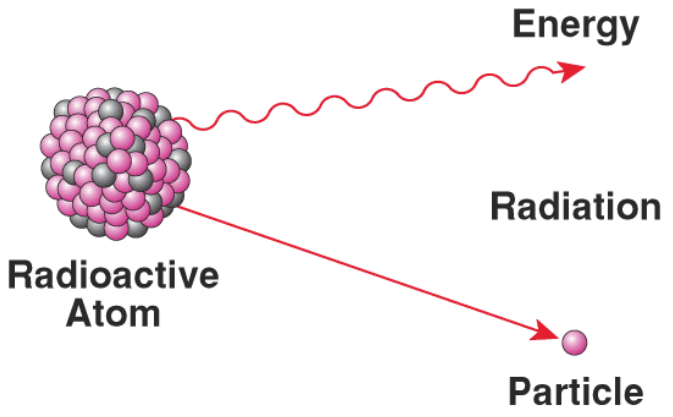
JACOB CURRY

RADIATION

Have you ever wondered how the same energy that brought about the end of the Second World War is used by dentists to take pictures of your teeth? Radiation has a wide variety of applications in many different fields.

WHAT IS RADIATION?

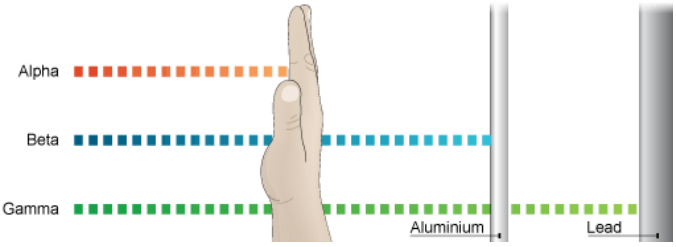
Radiation is the product of unstable atoms giving off energy as they decay to a more stable form. This energy exists in three main forms: alpha, beta, and gamma (x-ray) radiation. Alpha radiation particles have the least ability to penetrate matter. Alpha particles have the potential to travel just a few centimeters before their energy is expended. Alpha particles are easily stopped by thin objects such as paper or your skin. Although alpha radiation sources are relatively harmless to humans while outside of the body, if ingested they can cause serious damage.



Radiation

Beta radiation particles can penetrate deeper than alpha particles, allowing them to travel farther and penetrate thicker surfaces. Beta particles can travel from one inch to 20 feet in the air and they require slightly more dense objects to stop them, such as a sheet of aluminum or heavy clothing like that of a firefighter.

Gamma or x-ray radiation is different from alpha and beta radiation because it is not a particle, but rather a photon, like light or radio waves. Because gamma radiation has a different form than alpha or beta particles, it can travel much greater distances and it has the ability to penetrate objects. Depending on the energy of the radiation source, gamma radiation can travel through the air more than hundreds of meters. Since gamma radiation is emitted in waves, rather than particles, it requires much more shielding to be stopped. Highly dense materials such as lead or concrete work well to stop it.



Alpha, Beta, and Gamma Radiation Penetration

HOW IS RADIATION MEASURED?

Radiation exposure is measured with two different units. In the International System of Units (SI), the amount of radiation absorbed from a source is measured in sieverts (Sv), millisieverts (mSv), and microsieverts (µSv). In the system usually used in the United States, absorbed radiation is measured in rems (rem), millirems (mrem), and microrems (µrem). These two systems of measurement aren't all that different, as 1 sievert is equivalent to 100 rems of radiation.

Radiation exposure can be measured through a variety of methods, the most iconic of which is the Geiger counter. A Geiger counter uses a gas-filled tube to which electricity is applied. When radiation is present, an electronic pulse is created in the tube. Many of these devices are equipped with speakers that generate the signature clicking noise with each pulse when in the presence of radiation. As science has progressed, smaller, more sensitive methods of detecting radiation have been developed.

WHAT IS A DOSE?

A radiation "dose" is how much radiation a person is exposed to over a certain period of time. The dose is calculated by the amount of radioactivity that a person is exposed to from a source per hour, multiplied by the total time exposed to the source. For example, if someone were exposed to a 20 mrem/h source for 10 hours, they would receive a total dose of 200 mrem.

IS RADIATION DANGEROUS?

While radiation might seem dangerous, it is actually a lot more commonplace than you may think. Everyday, we are exposed to natural sources of radiation (such as sunlight, certain foods, water, cosmic radiation, and radon gas in the air) that emit what is called background radiation. Artificial sources include x-ray equipment, televisions, computers, and even cell phones. Although all of these materials emit some radiation, the amount is so low that it is considered not harmful to humans. The average dose from natural sources in the United States is 624 mrem per year; most of that is from medical sources.

While the small amount of background radiation we are exposed to may not be dangerous, being exposed to higher amounts of radiation can be harmful to humans. Individuals exposed to high doses of radiation may experience a range of side effects from illness and hair loss to, in extreme cases, death. The length of time and the concentration of the exposure to the radiation source determine the extent of harm. For most people, being exposed to radiation in any form beyond background radiation is unlikely.

LIAN LUCANSKY

RADIATION MONITORING

The simple thought of a radioactive substance makes some people cringe and others squirm at the possible consequences of exposure. These people may not realize that radioactive materials, while not to be toyed with, surround us everyday — primarily in the technology we have come to use so avidly. Even the environment around us gives off natural radiation! With Argonne's groundbreaking energy research, some radioactive materials are used. In this section, we will broach many questions pertaining to concerns about these materials in an attempt to evaluate how impactful they truly are: Where do radioactive materials go after they are used? Do they affect the community? How are radiation levels monitored and tested?

Radiation travels primarily in three ways: by air, water, and by direct radiation exposure. Argonne analyzes the air, water, and direct radiation at different locations inside and outside the facility to monitor what impact — if any — its radiological programs have on its neighbors and the environment. This section summarizes the most important findings of Argonne's radiological monitoring program. This analysis is conducted to ensure compliance with the U.S. Department of Energy's (DOE) radiation protection standards. This year, as in years past, Argonne has not only complied with these laws, but the measurable radiation levels are well below the maximum standards for radioactive emissions.

AIR SAMPLES

Air samples are collected with high-volume air samplers that collect particles in the air on fiberglass filters that are analyzed weekly for radioactive content. There are 15 of these samplers in total, 11 on-site and 4 off-site. Once these filters are collected, they are stored for one week before analysis, allowing natural radiation to dissipate. A small circle is then cut from the filter and analyzed for alpha and beta radiation and then the balance of the filter is used to measure gamma radiation. Table 2 shows the alpha and beta activity results for each month in 2012. During most months, the on-site and off-site alpha radiation levels (activities) were essentially the same and the on-site beta activities were only slightly higher than the off-site results. The results in Table 2 indicate that Argonne is not a significant source of airborne radioactivity.

WATER SAMPLES

Water samples are collected by trained staff and analyzed for radioactive materials. Wastewater is never dumped prior to treatment and testing. Wastewater from facilities that handle radioactive material is put into retention tanks and tested for radioactive content. It is analyzed for alpha and beta activity and, if it is below the regulated limits, it is released. If it exceeds the standards, the water is taken to a separate facility that removes the radioactive materials. After the treatment process is complete, the water is discharged to the sewer where it is treated prior to being discharged into Argonne's Sawmill Creek.

To ensure that radioactivity was not being released into surface water, water samples were taken regularly from the wastewater discharge, Sawmill Creek, and the Des Plaines River and tested for radioactivity. Samples of wastewater and Sawmill Creek downstream of Argonne were collected daily and analyzed weekly. Sawmill Creek upstream of Argonne was sampled and tested monthly, acting as a control to compare to the results from downstream samples. The 2012 results were lower than the previous year's results and far below DOE standards. The results show that the downstream Sawmill Creek radiation amounts are often lower than upstream values, indicating that Argonne does not expose the public to radiation that is higher than normal background levels.

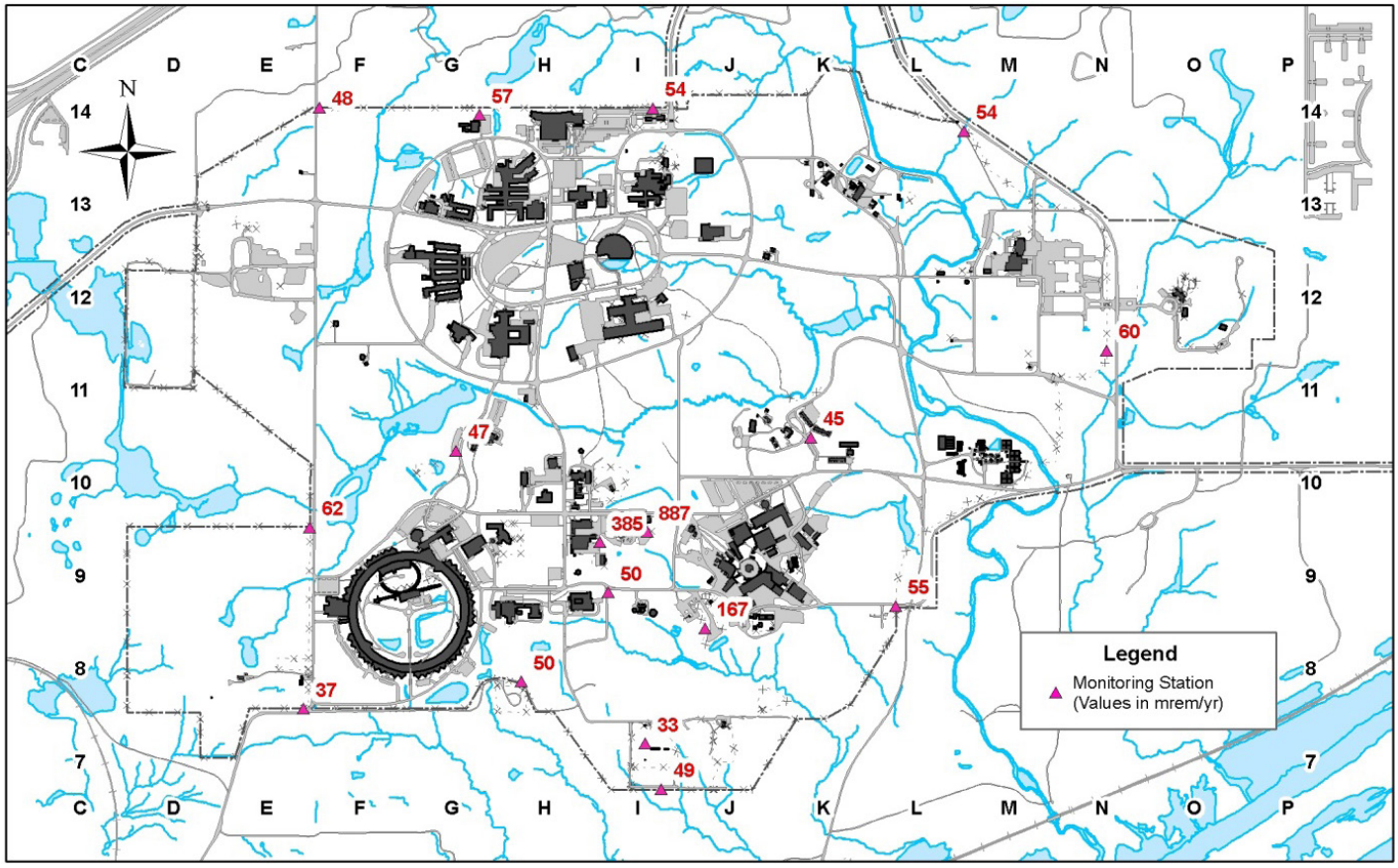
Sawmill Creek flows into the Des Plaines River. To ensure that discharges from Argonne are not contaminating the river, water above and below the wastewater discharge point is collected and analyzed monthly. The same levels were found above and below the discharge point and were all within normal ranges. This proves that Argonne does not contribute significant radioactivity to the Des Plaines River.

Sediment samples from Sawmill Creek were taken in mid-September to test if radioactivity had been building up in sediment. The results showed that very low amounts of cesium-137, plutonium-238, plutonium-239, and americium-241 were present in the sediment. The amount of these radionuclides in sediment remains at a level similar to past years. Even though low levels of radionuclides can still be seen in the sediment, radioactivity levels in the water are decreasing and creating a healthier environment for the surrounding populations and ecosystems.

EXTERNAL GAMMA RADIATION

Additional measurements were taken to evaluate the impact that direct radiation may be having on Argonne's surroundings. External gamma radiation was measured by dosimeters (radiation monitors) at 22 total sites — 17 on the Argonne site, most of which are on the site perimeter, and 5 off-site. The off-site locations provide a reference point to compare with the on-site measurements to determine if the on-site doses are significantly higher than normal background levels. Comparing the on-site and off-site results, it can be said with a 95% confidence rating that the radiation levels at most points are consistent with natural background levels. Table 2 and the figure on the next page show the on-site monitoring stations and the dose measured at each station during 2012. Higher levels of radiation dose on the map indicate locations where radioactive waste is temporarily stored in steel containers. Storage of waste creates an increased radiation dose near the waste containers.

TABLE 2 – AIR SAMPLING RESULTS (2012)			
MONTH	LOCATION	ALPHA ACTIVITY (fCi/m^3)	BETA ACTIVITY (fCi/m^3)
January	Perimeter Off-Site	1.90 2.20	32.18 24.85
February	Perimeter Off-Site	1.25 1.20	24.18 19.70
March	Perimeter Off-Site	1.77 1.85	22.88 18.87
April	Perimeter Off-Site	1.63 1.59	20.09 16.10
May	Perimeter Off-Site	1.56 1.46	19.48 16.88
June	Perimeter Off-Site	1.70 1.23	20.33 18.84
July	Perimeter Off-Site	2.04 2.12	25.13 24.87
August	Perimeter Off-Site	1.84 1.64	25.65 22.62
September	Perimeter Off-Site	1.50 1.31	23.96 22.08
October	Perimeter Off-Site	1.65 1.52	26.10 19.84
November	Perimeter Off-Site	2.97 2.81	36.93 36.27
December	Perimeter Off-Site	2.74 2.90	40.59 33.33



Locations of monitoring stations and dose measured during 2012

continued... Radiation Monitoring

EFFECT ON COMMUNITY

To measure the potential impact that the radiation released may have on the community, Argonne conducted an interesting study. A fictional scenario of a person who lives outdoors on Argonne's grounds all year and drinks water only from Sawmill Creek was assumed and the maximum potential radiation dose for this hypothetical individual from Argonne was estimated. This study provides a very conservative estimate of the maximum possible amount of radiation someone could be exposed to by Argonne's activities. By taking measurements of radioactive releases from all facilities, Argonne calculated that this fictional person would be exposed to far less radiation than allowed by DOE standards. The total estimated dose to this fictional individual was estimated to be 0.015 mrem/year compared to the DOE standard of 100 mrem/year for a member of the public. This amount of radiation is very small compared to the average annual natural background radiation dose of 624 mrem/year.

To present the estimated radiation dose another way — Argonne calculated the estimated amount of radiation dose that the surrounding community, as a whole, was exposed to during 2012 — due to Argonne's work. These numbers are shown in Table 3. The total population dose amount of 0.6 person rem was a very small fraction of the dose this population received from natural background sources.

Argonne can state with confidence that the community surrounding the laboratory is safe from radiation that is produced by Argonne activities, as is the surrounding environment. This can be seen through the results of extensive monitoring of water, sediment, and air samples as well as by measurements of direct radiation from dosimeters. With these results, it can be assured that Argonne is maintaining a safe environment while continuing their search for cleaner energy.

TABLE 3 – POPULATION DOSE WITHIN 80 KM (50 MI) (2012)

RADIONUCLIDE	PERSON-REM
Carbon-11	<0.01
Nitrogen-13	0.30
Oxygen-15	<0.01
Lead-212	0.28
Bismuth-212	<0.01
Uranium-235	<0.01
Total	**0.60**
Dose from natural sources	2.8×10^{6}

KWAME ASANTE-ABABIO

ENVIRONMENTAL NONRADIOLOGICAL MONITORING

Argonne's research and development focuses on four areas: clean energy; biological systems, environmental protection; and national security. Undeniably, research, experiments, and other activities at Argonne produce chemicals and waste materials that are released into the environment. Some of these chemicals are radioactive, although most are not. Argonne diligently monitors for these chemicals. The monitoring program that focuses on nonradioactive chemicals is called the Environmental Nonradiological Program.

As part of the Environmental Nonradiological Program, Argonne monitors for the release of nonradioactive chemicals and their effects on the environment. Nonradioactive materials in the air and water in sufficient quantities can be harmful to humans, and this is why Argonne makes sure to monitor the environment. Some of these nonradioactive substances include sulfate (SO_4^{-2}), chloride (Cl^-), copper (Cu), methane gas (CH_4), and volatile chemicals and petroleum products that are used in Argonne laboratories and other facilities. Argonne monitors for these and other nonradioactive substances that are released to the air and the surrounding surface and underground water.

In operations and research at Argonne, nonradioactive volatile chemicals are used. Volatile chemicals are chemicals that vaporize at low temperatures and thus, they can be released to the air we breathe. Argonne is required by the Clean Air Act to monitor for such air pollutants. The Clean Air Act is a federal statute that addresses the emission of regulated air pollutants. Some of these air pollutants released from Argonne's wastewater treatment facility include bromoform, chloroform, and bromodichloromethane — which are all produced when chlorine is added to drinking water during treatment. Cleaning solvents such as acetone and ethanol are also used and end up in Argonne wastewater. During treatment, these chemicals are released to the air. Monitoring of these chemicals shows that they are released to the air in very low quantities. Another air pollutant that is monitored is methane gas, which is produced when solid waste decomposes in a closed solid waste landfill. Methane gas can be a fire hazard if it is present in high enough concentrations. If humans were to breathe in methane gas in excessive quantities, it could be harmful to their health. Therefore, Argonne ensures that the amount of methane gas near the landfill is very low and it will not be harmful to the people in and around the Argonne site.

continued... Environmental Nonradiological Monitoring

Argonne also monitors the release of nonradioactive chemicals into surrounding water bodies from laboratory work and facilities such as bathrooms and the cafeteria. Before wastewater is discharged into Sawmill Creek, south of Argonne, it is treated in two on-site wastewater treatment plants to remove most of the nonradioactive chemicals. Argonne monitors the water treatment systems to check the amount of nonradioactive chemicals that are released to surrounding water bodies. Argonne is required by the Clean Water Act to routinely collect samples of the wastewater for testing.

Argonne scientists collecting surface water samples

Because Argonne is aware that the wastewater may contain various nonradioactive chemicals, it voluntarily conducts analyses on samples that are collected from other water bodies at the site and off-site. This extra monitoring helps Argonne stay alert for dangers that their activities may be posing to the environment and people.

Chemicals and other parameters that are monitored in wastewater and nearby water bodies include mercury, oil, grease, iron, and pH (the acidity or basicity of the water). Occasionally, storm water is sampled after a rain event and tested for nonradioactive chemicals. Frequent testing helps Argonne keep accurate track of the amounts of nonradioactive chemicals in the water bodies.

From the 2012 data, the only chemical in excess of the allowable limits was ammonia in two samples of the treated wastewater. The amount of dissolved oxygen in the treated wastewater was lower than the regulations allow on eight occasions in 2012 due to unusually hot weather. Some other nonradiological chemicals were present in both the wastewater and surrounding water bodies in such small quantities that they could not affect the people in and around the Argonne site.

RYAN HOLTROP

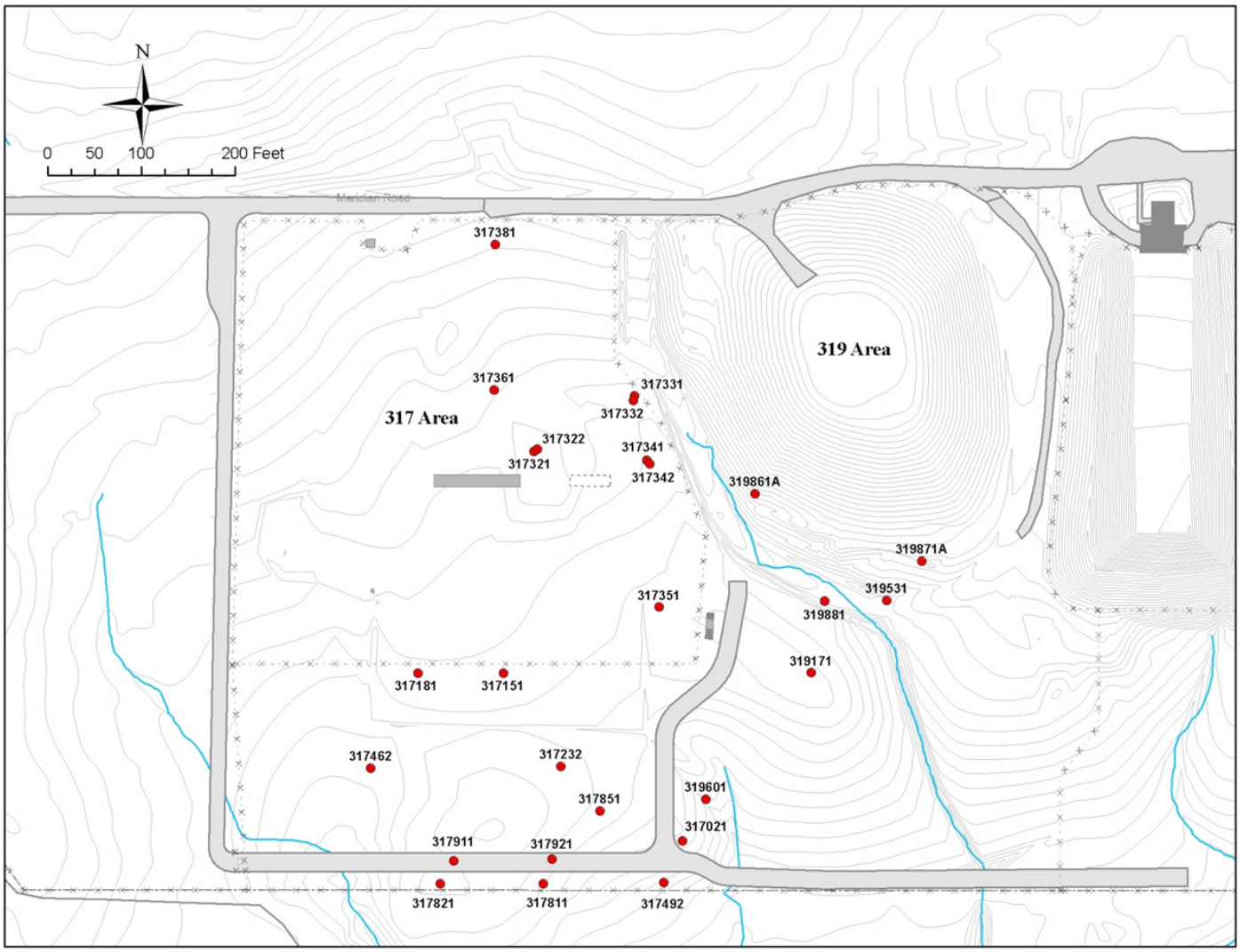
GROUNDWATER MONITORING

Water is all around us. It's in the sky, in you and me, and even in the ground. The water under the ground is called groundwater. This section explains how Argonne is properly protecting groundwater as well as what Argonne is doing to make groundwater safe for its surrounding neighbors and the ecosystem. To do this we need to address three issues. First, what is groundwater and how is Argonne testing groundwater? Second, what types of chemicals are in groundwater? Third, why does Argonne environmentally monitor groundwater? By addressing these issues, we will learn more about Argonne in general and about Argonne's continued efforts to be not only a pillar of the research community but also a good neighbor.

What is groundwater? Groundwater is defined as the water that moves beneath the surface of the earth through layers of porous earth and rock.

How is Argonne testing the groundwater on-site? For Argonne's monitoring staff to test groundwater, they need to collect and analyze samples from a series of monitoring wells distributed throughout the site and adjacent to Argonne's property boundaries. A critical part of this monitoring program is checking the groundwater surrounding the former waste disposal site known as the 317/319 Area. Argonne checks these sites because these were former chemical waste disposal sites. The figure below shows the monitoring wells around the 317/319 Area.

Argonne scientists collecting groundwater samples



Map of monitoring wells near the 317/319 Area, a former chemical-waste disposal site

We also need to address what else is in the ground that might damage groundwater. During the early years of Argonne, at its present site, certain types of wastes were disposed of in a number of on-site waste management units like the 317/319 Area. Several of these on-site waste management units were used to dispose of chemically hazardous wastes. These wastes still pose a threat to the environment. If the wastes were to get out of these sites and into the air or drinking water, they could possibly cause serious damage to a person's health. No radioactive waste was knowingly disposed of in any waste disposal unit at Argonne. But some radiologically contaminated equipment and debris was placed in a few areas of Argonne; therefore, several of these locations were contaminated with small amounts of radioactivity.

So what shows up in Argonne's groundwater testing today? Several chemicals used as cleaning solvents are found in the 317/319 Area. Hydrogen-3 is also found in the groundwater in this area. Hydrogen-3 is also known as tritium and it is a radioactive isotope of hydrogen. The tritium nucleus, called a triton, contains one proton and two neutrons. It has a half-life of 12.5 years and decays by beta-particle emission. The amount of tritium in groundwater at Argonne is usually low enough that it is below the allowable limit for drinking water.

Lastly, we need to address why Argonne monitors groundwater. This monitoring is done to measure Argonne's impact on groundwater quality from wastewater discharges, air discharges, and material released to the soil and groundwater. Argonne has stated that the purpose for monitoring groundwater near closed waste sites is to track the movement of contaminated groundwater, to determine the rate at which contaminant levels are decreasing, and to monitor the performance of the various environmental remedial actions constructed in these areas. One way Argonne is working to fix these contaminated zones is by using hybrid poplar and willow trees in a process known as phytoremediation. In 1999, Argonne planted 950 willow and

continued... Groundwater Monitoring

poplar trees in special lined boreholes that were designed to guide the roots toward the contaminated zone. The trees slowly remove the contaminated groundwater as they grow.

After all of the monitoring that Argonne has done, it has found that most of the water under Argonne is clean, but there are some hazardous chemicals in the ground in the 317/319 Area that have an effect on the groundwater. Argonne is taking care of the situation by preventing the wastes in the ground from damaging the groundwater.

KYLIE TOERPE

WILDLIFE AND HABITAT MANAGEMENT

What if the world were not kept healthy? What if endangered species were not protected, historic sites were not marked, habitats not maintained, and animal populations were not kept in check? According to John Ruskin, the 19th century British art critic whose ideas are recognized today as having foreshadowed our modern interests in the environment and sustainability, "Nature is painting for us, day after day, pictures of infinite beauty." At Argonne National Laboratory, scientists are working hard to keep that nature beautiful. Land management and habitat restoration are the processes of keeping the land healthy and maintaining its natural state. It also includes removing invasive species and keeping everything about an ecosystem balanced. It is a difficult task, yet every year Argonne keeps at it.

Students assessing prairie conditions

NATIONAL HISTORIC PRESERVATION

Historic preservation is important to Argonne and its neighbors; it is crucial to the survival of historic artifacts on the property. Necessary precautions are taken when work is planned in areas of significance. The National Historic Preservation Act requires that federal agencies assess locations to determine whether or not the area needs to be protected. If a proposed site has not yet been surveyed, a group of qualified individuals is appointed to survey the land. Once a location has been evaluated and cleared, the project may begin. Assessment and evaluation of a location looks at the potential impact to a possibly historic site and if any proposed digging would damage the site. Argonne has areas within its property that have previously been identified as historic sites; identification of all historic sites within Argonne is still in progress. Argonne has already examined roughly 529 acres of land and roughly 745 acres are still to be examined. It has been determined so far that there are 55 historic sites on Argonne land, three of which are qualified to be listed in the National Register of Historic Places. These three places contain the remains of what are now historic farmsteads and are not to be disturbed by digging.

ENDANGERED SPECIES

There is a considerable amount of care and concern for endangered species at Argonne. Every new Argonne project proposal is evaluated for potential harm to endangered species. If adverse impact is considered likely, the project is discussed with the U.S. Fish and Wildlife Service. If necessary, development plans are changed to more thoroughly protect the species. Argonne does not have any species on the federally-listed endangered species list. The following are state-listed endangered and threatened species that live on and around the Argonne site:

Endangered

- Black-crowned night heron (*Nycticorax nycticorax*)
- Blanding's turtle (*Emydoidea blandingii*)
- Eastern massasauga (*Sistrurus catenatus catenatus*)
- Osprey (*Pandion haliaetus*)
- Tennessee milkvetch (*Astragalus tennesseensis*)
- Tuckerman's sedge (*Carex tuckermanii*)
- Yellow-crowned night heron (*Nyctanassa violacea*)

Threatened

- Black-billed cuckoo (*Coccyzus erythropthalmus*)
- Buffalo clover (*Trifolium reflexum*)
- Kirtland's snake (*Clonophis kirtlandi*)
- Marsh speedwell (*Veronica scutellata*)
- Shadbush (*Amelanchier interior*)

Heron at Argonne National Laboratory

PRAIRIE RESTORATION

Argonne is currently working toward the retention of habitats and the removal of invasive species from its campus. Restoration is extremely important to Argonne — as they research and study nature and if that nature is in its most healthy and original state — it is the most beneficial to both inhabitants of the area and to Argonne for their research. Many steps have been taken to return the land that is under Argonne's care back into its original, healthy, natural state. Each year, Argonne begins 3–5 acres of prairie restoration and 30–60 acres of invasive species control. In 2012, 3 acres of land were added to prairie conversion and 30 acres of woodland were treated to keep invasive shrubs and other plant species under control. The work continues to restore the land and keep it healthy.

Student examining prairie plants

WETLANDS

Floodplain and wetland management is also important to Argonne. Argonne itself is not subject to major flooding, as the closest body of water is the Des Plaines River and the facility sits about 150 feet higher than the river. Argonne ensures that these areas are not harmed, as development is prohibited in areas where floodplains exist. If a proposed project threatens a floodplain, a detailed report is prepared to evaluate the proposed project and its potential impacts. In addition to managing floodplain development, the U.S. Army Corps of Engineers also regulates the disturbance of wetlands. Since 1987, all wetlands in Argonne have been identified and mapped. An advanced compensatory mitigation, which is similar to a wetland "bank," is used to counteract wetland losses caused by development.

Student examining wetland plants

Students sharing information about plant identification

WILDLIFE MANAGEMENT

Deer management began at Argonne in the year 1995 to eliminate the danger that their large numbers posed to the ecosystem, as well as to alleviate traffic hazards. In the winter of 1995–1996, more than 600 deer were removed from Argonne and more than 80 were removed the following winter. Since 1997, smaller numbers of deer have been removed. Over the past few years, the deer density has decreased, which has allowed oak trees and deer-sensitive herbaceous species to restore themselves. The remaining population of exotic white fallow deer has decreased in recent years; only a few individuals are still present on-site. The deer population will continue to be managed, as they still may overpopulate and again threaten biodiversity on Argonne's campus.

White fallow deer

Argonne NATIONAL LABORATORY

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U.S. DEPARTMENT OF ENERGY

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