In Summary:
Idaho National Engineering Laboratory
Site Environmental Report
for Calendar Year 1995

Donny Roush
Russell G. Mitchell
Don Peterson

Environmental Science and Research Foundation
Doyle Markham, Executive Director

August 1996

Program Conducted for the U.S. Department of Energy under
Contract DE-AC07-94ID13268 by the
Environmental Science and Research Foundation
101 S. Park Avenue, Suite 2
P.O. Box 51838
Idaho Falls, Idaho 83405-1838

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
electronic image products. Images are
produced from the best available original
document.**

THE INEL'S ENVIRONMENT DURING 1995 AT A GLANCE

Each year, the state of the environment at the Idaho National Engineering Laboratory (INEL) is assessed in a Site Environmental Report. The Environmental Science and Research Foundation compiles data collected from routine environmental monitoring programs conducted on and around the INEL. Recently, the report *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1995* was prepared and published. The Environmental Science and Research Foundation prepared this summary to highlight findings from that report.

- Scientists from the Environmental Science and Research Foundation, Lockheed Martin Idaho Technologies Company, the U. S. Geological Survey, and other Idaho National Engineering Laboratory (INEL) contractors monitored the environment on and around the INEL to find contaminants attributable to the INEL. During 1995, all exposures from the INEL to the public were negligible.
- Pathways by which INEL contaminants might reach people were monitored. These included: air, precipitation, water, soil, locally grown food (wheat, milk, potatoes, and lettuce), game animals, and direct radiation.
- According to the 1995's results, nearly all radioactivity related to INEL operations was not distinguishable from natural radioactivity and worldwide fallout from nuclear weapons testing carried out in the 1950s and 1960s. Radiation from natural sources and weapons testing is called "background radiation."
- The man-made radionuclides americium, plutonium, and strontium were found in the air at four locations on the INEL. Contaminants in air around the Radioactive Waste Management Complex were linked to construction activities which resuspended contaminated soil into the air. No source was determined for plutonium detected at the Idaho Chemical Processing Plant and Power Burst Facility. The concentrations of these radioactive substances were well below health and safety standards.
- Because radiation from the INEL was not detected by offsite environmental surveillance methods, computer models were used to estimate a radiation dose to people. The hypothetical maximum individual dose from the INEL was calculated to be 0.018 millirem. That's 0.005 percent of an average person's annual dose from background sources in southeast Idaho.

Introduction

Every human is exposed to natural radiation. This exposure comes from many sources, including cosmic radiation from outer space, naturally-occurring radon, and radioactivity from substances in our bodies. In addition to natural sources of radiation, humans can also be exposed to man-made sources of radiation. Examples of man-made sources include nuclear medicine, X-rays, nuclear weapons testing, and accidents at nuclear power plants.

The Idaho National Engineering Laboratory (INEL) is a U. S. Department of Energy (DOE) research facility that deals, in part, with studying nuclear reactors and storing radioactive materials. Careful handling and rigorous procedures do not completely eliminate the risk of releasing radioactivity. So, there is a remote possibility for a member of the public near the INEL to be exposed to radioactivity from the INEL.

Extensive monitoring of the environment takes place on and around the INEL. These programs search for radionuclides and other contaminants. The results of these programs are presented each year in a site environmental report. This document summarizes the *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1995*.

The INEL is located in southeast Idaho.

INEL History

This federal reserve was founded by DOE's predecessor, the Atomic Energy Commission, as the National Reactor Testing Station in 1949. The Site was selected as a remote place for building and testing nuclear reactors. It was renamed the INEL in 1974 to better reflect its expanded mission. Today, the INEL's mission encompasses advanced systems engineering, safe storage of radioactive waste, hazardous waste and spent nuclear fuel, and environmental management. It employs more than 8,000 people and operates on a budget of about \$750 million. In the quest for a safe and economical new source of energy for the United States, 52 reactors have been built at the INEL. Of these 14 are still operable or operating.

Where is the INEL?

Located on the eastern Snake River Plain of southeastern Idaho at an average elevation of 4,900 feet, the INEL encompasses 890 square miles. It extends 39 miles from north to south and is up to 36 miles wide in its southern portions. The land is a high, cool desert, known as a sagebrush steppe. The INEL's activities take place largely at eight facilities. Most of the INEL's land is open, with about 94 percent of the Site undeveloped. Lands immediately beyond the boundaries of the INEL are either open desert or farms, with most of the nearby farming conducted northeast of the INEL. About 60 percent of the INEL's lands are open to grazing.

Beneath the INEL is the Snake River Plain Aquifer, a vast underground water body.

Most of the water in the aquifer comes from the mountainous area around the Henry's Fork of the Snake River, with additional contributions from the Big and Little Lost Rivers, and the Birch Creek drainages. The underground water moves southwest at a rate of about 5 to 20 feet per day. It reappears in springs along the Snake River between Burley and Bliss, Idaho. Both the ground water and surface waters of the Snake River Plain are used for crop irrigation and drinking water.

INEL Facilities

During 1995, six of the eight major INEL facilities were operated by Lockheed Martin Idaho Technologies Company (LITCO), which received a consolidated contract for the Site in October 1994. The Naval Reactors Facility is managed by Westinghouse Electric Corporation and Argonne National Laboratory-West is managed by the University of Chicago. Several INEL buildings in Idaho Falls house research, support and oversight personnel.

The eight major facilities at the INEL are:

- Argonne National Laboratory-West (ANL-W)
- Idaho Chemical Processing Plant (ICPP)
- Test Area North (TAN)
- Test Reactor Area (TRA)
- Power Burst Facility (PBF)
- Naval Reactors Facility (NRF)
- Radioactive Waste Management Complex (RWMC)
- Central Facilities Area (CFA)

The INEL has eight major facilities within its 890 square-mile area.

Environmental Laws and Regulations

The INEL strives to operate in compliance with all environmental laws, regulations, executive orders, DOE Orders, and compliance agreements with the Environmental Protection Agency and the State of Idaho. Major environmental laws and regulations include:

- Comprehensive Environmental Response, Compensation and Liability Act (Superfund)
- Emergency Planning and Community Right-to-Know Act
- Clean Air Act
- Clean Water Act
- State of Idaho Wastewater Land Application Permit Regulations
- Resource Conservation and Recovery Act
- National Environmental Policy Act
- Safe Drinking Water Act
- National Historic Preservation Act
- Native American Grave Protection and Repatriation Act
- Endangered Species Act

Chapter 2 in *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1995* reviews the current compliance status with these environmental statutes.

Two of the largest programs at the INEL are Environmental Restoration and Waste Management. The Environmental Restoration Program focuses on cleanup activities. These include stabilizing contaminated soil; pumping, treating, and containing ground water; decontaminating, decommissioning, and demolishing abandoned buildings; and exhuming sludge and buried drums of waste. To facilitate this complex process, the INEL was divided into 10 Waste Area Groups (WAGs). Within each WAG are up to as many as 70 individual studies involving waste. Each WAG is undergoing, or will begin in 1996, a comprehensive investigation

to determine what is known about the contamination there, if anything more needs to be learned, and what risks the contamination poses. Based on this information, a cleanup plan is proposed. After a period of public scrutiny, a revised plan for each WAG is implemented. Comprehensive investigations take an average of two years to complete.

The Waste Management Program aims to protect humans and the environment, while properly handling, treating, storing, and disposing of wastes at the INEL. An emerging philosophy is to prevent generating pollution in the first place, and to minimize the amount when waste production cannot be avoided. As a major component of this program, the INEL recently was named the lead DOE laboratory in devising new technology and techniques for managing mixed waste—that which is both hazardous and radioactive.

Chapter 3 in *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1995* explains the activities of the Environmental Restoration and Waste Management programs in more detail.

Environmental Monitoring

Normal operations at INEL facilities regularly release various materials into the environment.

These releases may contain radioactive materials, though they often do not. An extensive environmental monitoring program is conducted to identify and quantify all releases resulting from INEL activities.

Why Monitor the Environment?

According to agency regulations as well as federal and state laws, environmental surveillance must be conducted to monitor the environmental effects, if any, of DOE activities. The environmental monitoring and surveillance programs are designed to:

- protect the health of the public and environment;
- verify compliance with applicable environmental laws and regulations, and with commitments made in official DOE documents;
- look for trends in the physical, chemical and biological conditions of the environment on and around the INEL;
- assess the potential radiation dose to members of the public from INEL operations.

Monitoring vs. Surveillance: What's the Difference?

Environmental monitoring consists of two separate activities: *effluent monitoring* and *environmental surveillance*. Effluent monitoring measures contaminants where they are released. Environmental surveillance looks for and measures contaminants that have dispersed into the environment. Potential environmental pathways by which contaminants could be transported

from the INEL include foodstuffs grown in the vicinity of the INEL, inhaled air, game animals which live on the INEL and are later taken by hunters, and ground and surface water.

The operating contractors at each INEL facility are responsible for monitoring the releases from their facilities and for any surveillance performed within their facility fences. Results of these programs are reported annually by each organization. Throughout 1995, the onsite environmental surveillance program for the INEL was conducted by LITCO. The offsite portion of the environmental surveillance program was conducted by the Environmental Science and Research Foundation, a nonprofit organization also active in INEL ecology research and

Potential environmental pathways from the INEL to humans.

environmental education. Ground-water surveillance was conducted by the U.S. Geological Survey (USGS), and weather patterns were characterized by the National Oceanic and Atmospheric Administration (NOAA). These data were used in part to compute radiation doses to members of the public. An independent verification program was also operated by the State of Idaho INEL Oversight Program.

Program Descriptions

Speaking the Radiation Language

Samples from environmental pathways and effluent streams are tested for radioactivity and other contamination. When discussing results from these tests, scientists use many special terms. In order to understand the implications of the results of these tests, one must first understand the radiation "language."

Some atoms contain too much energy and are unstable. They try to become stable by releasing their excess energy as either waves or particles. These waves and particles are called **radiation**.

A **radionuclide** is a radioactive form of an element. For example, tritium is a radioactive form of hydrogen.

A **curie** is a unit used to measure the amount of radioactivity in a sample. It is abbreviated as **Ci**.

A **rem** is a unit used to measure the amount of radiation dose to humans. A **millirem** is 1/1000 (one thousandth) of a rem.

A **person-rem** is the sum of the radiation doses received by all individuals in a population. This concept can also be expressed in **person-millirem**.

Gross analyses detect the total amount of specific types of radioactivity (**alpha, beta, gamma**) in a sample, but do not identify the individual radionuclides.

Half-life is the time required for one-half of a radioactive material to decay. Therefore, the shorter the half-life, the faster a radioactive material decays.

Radiological Surveillance Program

Air is the most direct pathway for contaminants from the INEL to reach the offsite environment. Therefore, air is sampled more frequently than other pathways. Both high-volume and low-volume air samplers were used to measure airborne radioactivity. Air filters from the high-volume samplers were changed daily; whereas filters from the low-volume samplers were

changed weekly. LITCO operated two high-volume air samplers on the INEL. A total of 15 low-volume air samples were located on the INEL, and an additional 15 low-volume air samplers were located off of the INEL.

Monthly precipitation samples were collected in Idaho Falls and on the INEL; a weekly sample was collected on the INEL when there was measurable precipitation. INEL contractors collected onsite drinking water samples from their facilities each month during January through June; a quarterly schedule was adopted beginning in July, except at NRF which continued sampling monthly. The Foundation collected water from the Snake River and from 14 drinking water supplies, at both boundary and distant locations, twice per year. In addition, the Foundation also collected quarterly samples from three springs in the Magic Valley of south-central Idaho.

No streams or rivers flow from within the INEL to offsite locations. But, water monitoring is still an important surveillance activity because the INEL is located directly above the Snake River Plain Aquifer and past waste management practices included injecting wastes directly into the aquifer. The U.S. Geological Survey (USGS) monitors the Snake River Plain Aquifer under and near the INEL, as well as "perched" pockets of ground water above the aquifer. Perched water is not at the surface, nor is it part of the aquifer.

The USGS maintains about 125 aquifer observation wells, 40 wells for sampling perched water, and more than 120 auger holes to monitor shallow perched water. They test samples for both radiological and non-radiological contaminants. The USGS also publishes special studies detailing conditions in the aquifer. Documents released in 1995 included reports on aquifer-wide

water movement and pollution; contaminants in selected wells between the INEL and Hagerman, Idaho; chemicals found in wells near NRF; and the geology and chemical composition of rocks beneath the INEL. For more information about the USGS water monitoring program, call the USGS INEL Project Office, (208) 526-2438.

The Foundation collected samples of milk, wheat, garden lettuce, and potatoes, from places near the INEL boundary as well as distant from the INEL. They also sampled liver, thyroid, and muscle tissues from sheep that grazed on the INEL and of big game animals accidentally killed on INEL roadways. Sheep and game animals represent a potential pathway to people who might consume animals that came into contact with contaminants while on the INEL. Milk, wheat, lettuce, and potatoes were included in the program because they are a part of a typical American diet and represent potential pathways for radionuclides from INEL operations. Potatoes are also an important agricultural crop and source of revenue for southeast Idaho.

Game Ingestion Pathway

The INEL is home to hundreds and hundreds of game animals, many of which leave the INEL during summer and autumn, and can be hunted during regular hunting seasons. The potential dose to an individual from ingestion of meat from game animals is calculated.

Results of a 1984-86 study of waterfowl using radioactive waste ponds on the INEL found that the potential dose to a person eating the entire liver and muscle mass of the most contaminated duck in the study was 4.0 millirem. The group of ponds where this duck was taken have since been drained and replaced by ponds with plastic liners. A new study is underway to determine the effect of the lined ponds on radionuclide concentrations in waterfowl.

Pronghorn antelope are the INEL's most visible game animal. An estimate of the dose to a person eating the entire muscle and liver mass of an INEL pronghorn with the highest level of radionuclides found during the last five years is 0.03 millirem. (A more complete discussion of dose begins on page 24.)

Soil is sampled by the Foundation during even-numbered years. So, it was not part of the routine surveillance program for 1995. Onsite, soil at facilities is collected on a seven-year rotating schedule.

Environmental dosimeters were used to directly measure radiation in the environment. They were placed at seven distant locations, six boundary locations, and 135 locations on the INEL. Dosimeters were collected for analysis in May and November.

Water, food, and environmental dosimeter sampling locations around the INEL.

Radiological Effluent Monitoring Program

Known and measured amounts of radionuclides were released as airborne and liquid effluents at the INEL in 1995. Airborne and liquid effluents released to the environment were carefully monitored at potential release points. INEL contractors report these releases using several methods, as required by DOE as well as state and federal regulations.

Nonradiological Monitoring Programs

In addition to monitoring for radioactive contaminants in the environment, the INEL's surveillance program also routinely checks for nonradiological contaminants in the air and water. Air is monitored for particulates. These tiny particles, such as dust, nitrogen oxides, and sulfur

What Are NO_x and SO_x?

Under the federal Clean Air Act, two pollutants of concern are oxides of nitrogen (NO_x) and sulfur (SO_x). Each of these elements have more than one oxide. For instance, two common nitrogen oxides are nitrogen oxide (NO) and nitrogen dioxide (NO₂) and two common sulfur oxides are sulfur dioxide (SO₂) and sulfur trioxide (SO₃). Three of these four pollutants are measured at the INEL: nitrogen oxide, nitrogen dioxide, and sulfur dioxide.

At the INEL, these pollutants are measured at their source (as they are emitted from stacks) and in the environment. The amount that can be emitted is limited by permits issued by the State of Idaho. Concentrations found in the environment must be within standards set by the federal Environmental Protection Agency.

of waste at ICPP, the burning of coal, the burning of heating oil, motor vehicle exhausts, and dust produced by construction activities. Liquid effluents, including sewage, chemicals used for water treatment, and cleansers, are monitored and reported in many of the same ways.

oxides, can impair visibility and may cause breathing problems. Particulate concentrations were measured with the same low-volume air samplers used for radiological measurements.

The five major sources of these nonradiological airborne emissions at the INEL are nitrogen dioxide emissions from treatment

What is IMPROVE?

Interagency Monitoring of Protected Visual Environments (IMPROVE) is a program designed to test for visibility at national parks, monuments and wilderness areas throughout the United States.

In 1992, an IMPROVE sampler was set up on the INEL, and another was established at Craters of the Moon National Monument, through a Memorandum of Understanding between the National Park Service and DOE.

IMPROVE sample analyses are performed by the Crocker Nuclear Laboratory at the University of California, Davis.

Specific radiological and nonradiological results from individual facilities, as well as bacteriological monitoring results can be found in Sections 5.2 and 6.4 in the *INEL Site Environmental Report for Calendar Year 1995*.

Radiological Results

Radiological Surveillance Results

Radiological environmental surveillance for 1995 found that most radioactivity from INEL operations could not be distinguished from worldwide weapons testing fallout and natural radioactivity. Offsite data indicated no measurable human health risks due to INEL operations. By comparison, each person in southeastern Idaho receives an annual radiation dose of about 360 millirem from sources besides the INEL. This is referred to as background radiation.

Radiological Effluent Monitoring Results

A total of 1,380 curies of airborne radionuclides were released during INEL operations in 1995. More than 99 percent of this radioactivity was in the form of short-lived and non-reactive gases. Because of rapid decay, the actual radioactivity that reached offsite areas was considerably less than 1,380 curies.

Radioactive liquids were placed into specially designed evaporation and seepage ponds. No liquids were released directly to the offsite environment. All discharges directly into the Snake River Plain Aquifer ceased in 1984. More than 99 percent of this radioactivity was placed in a heavy plastic-lined pond at TRA. Of the 84 curies put into the pond in 1995, 80 curies were from tritium, a radioactive form of hydrogen.

Radiological Surveillance Results for 1995		
Medium	What Was Found	What It Means
<p><i>Air</i></p> <p><i>High Volume</i></p> <p>454 high-volume air filters were collected and analyzed.</p>	<ul style="list-style-type: none"> No man-made radionuclides were indicated on any daily filter. Several man-made radionuclides were detected on monthly composites. 	<ul style="list-style-type: none"> All positive results were just above the minimum detectable concentration, and represents less than 0.01 percent of DOE's concentration guides.
<p><i>Low Volume</i></p> <p>1,560 low-volume air filters were collected and analyzed.</p>	<ul style="list-style-type: none"> During the year, a total of 12 man-made radionuclides were detected onsite, at a total on nine locations. Plutonium and americium were detected at the Radioactive Waste Management Complex in the second, third, and fourth quarters. Plutonium was detected at the Power Burst Facility and Experimental Breeder Reactor-I in the second quarter. Plutonium, americium, and strontium were detected at the Idaho Chemical Processing Plant in the third and fourth quarters. Americium was detected at several offsite locations during the third and fourth quarters. Radioactive iodine was detected on seven occasions. Substantial differences in gross beta radiation was measured on 5 percent of offsite filters and 9 percent of onsite filters. 	<ul style="list-style-type: none"> The presence of the man-made radionuclides plutonium and americium at the Radioactive Waste Management Complex and Experimental Breeder Reactor-I was attributed to contaminated soil particles made airborne by construction activities. The plutonium, americium, and strontium detected at the Power Burst Facility and Idaho Chemical Processing Plant are of unknown origin. The highest concentration indicated represents 1.6 percent of DOE's concentration guides. The origin of the americium was not determined. This radionuclide is present in soils worldwide as a result of nuclear weapons testing during the 1950s and 1960s. The concentration of iodine, likely from INEL activities, was just above the minimum detectable concentration, and represents less than 0.005 percent of DOE's concentration guides. Some of the differences detected may be due to INEL operations, but no specific sources could be identified.

Radiological Surveillance Results for 1995, continued

Medium	What Was Found	What It Means
<p><i>Atmospheric Moisture/Precipitation</i></p> <p>19 atmospheric moisture samples were collected and analyzed.</p> <p>43 precipitation samples were collected and analyzed.</p>	<ul style="list-style-type: none"> • A greater number of positive concentrations were measured, since lower concentrations of tritium could be detected. • Tritium was detected in four offsite atmospheric moisture samples. • Tritium was detected in 12 of the samples. 	<ul style="list-style-type: none"> • Improvements in laboratory techniques resulted in a lower detection limits for tritium. • The highest concentration of tritium was detected at a distant location. It represents 0.0007 percent of DOE's concentration guides. • Higher concentrations of tritium were detected at locations distant from the INEL, indicating that natural atmospheric processes and historic weapons testing were the likely source of the tritium.
<p><i>Water</i></p> <p>51 offsite water samples were collected and analyzed (32 drinking water and 19 surface water).</p> <p>224 onsite water samples were collected from wells and analyzed.</p>	<ul style="list-style-type: none"> • Four offsite samples had detectable concentrations of gross alpha radiation; 34 had detectable concentrations of gross beta radiation. • Eight of the offsite water samples contained detectable amounts of tritium. • 15 onsite well samples had detectable gross alpha radiation; 39 had detectable concentrations of gross beta. 	<ul style="list-style-type: none"> • All gross alpha and beta concentrations, except one, were within the expected concentration range for naturally occurring activity in the Snake River Plain Aquifer underlying the INEL and surrounding areas. A sample from the Snake River was found to contain excess sediment which caused an unusually high gross beta reading. • The highest offsite tritium concentration represented 0.02 percent of DOE's concentration guides. • All gross alpha readings and 36 of the gross beta readings were within the range expected for naturally occurring activity in Snake River Plain Aquifer. Three samples from the Idaho Chemical Processing Plant had elevated concentrations, possibly related to a strontium plume beneath the facility.

Radiological Surveillance Results for 1995, continued

Medium	What Was Found	What It Means
<p><i>Water</i>, continued</p>	<ul style="list-style-type: none"> • Tritium was detected in samples from Central Facilities Area, Idaho Chemical Processing Plant, INEL Rifle Range, and Radioactive Waste Management Complex. • Three onsite wells at Idaho Chemical Processing Plant showed detectable concentrations of strontium. A marked increase in strontium concentrations was indicated in June. • An effective annual dose of 0.7 millirem from drinking water was estimated for workers at Central Facilities Area, the INEL facility with the highest concentration of tritium in its water. 	<ul style="list-style-type: none"> • The water samples in which tritium was detected at Central Facilities Area, Idaho Chemical Processing Plant, INEL Rifle Range, and Radioactive Waste Management Complex were collected from a contaminant plume beneath the facilities. Its presence was previously known and the concentrations show a downward trend during the last five years. The plume was not detected in offsite groundwater. • Average concentrations of strontium at Idaho Chemical Processing Plant were consistent with findings from previous years, though it is unknown what caused the peak in June. • The effective dose estimate of 0.7 millirem for a worker at Central Facilities Area represents 18 percent of the federal community drinking water standard, as set by the Environmental Protection Agency.
<p><i>Environmental Dosimeters</i></p> <p>287 environmental dosimeters were collected and analyzed.</p>	<ul style="list-style-type: none"> • No statistical differences were seen between environmental radiation measured at boundary and distant locations. • Onsite measures of environmental radiation at Argonne National Laboratory-West, Auxilliary Reactor Area, Idaho Chemical Processing Plant, Radioactive Waste Management Complex, and Test Reactor Area were higher than background. 	<ul style="list-style-type: none"> • Radiation exposures off the INEL were not measurably increased due to INEL activities. • Higher radiation exposures at some INEL facilities were found in the vicinity of radioactive material storage areas and areas with contaminated soils.

Radiological Surveillance Results for 1995, continued		
Medium	What Was Found	What It Means
<p>Food</p> <p><i>Milk</i></p> <p>144 milk samples were collected and analyzed.</p>	<ul style="list-style-type: none"> • A sample from Roberts contained a detectable amount of radioactive iodine. • Improved laboratory techniques allowed tritium to be detected at lower concentrations. Tritium was subsequently detected in five samples. • Six of seven samples analyzed for strontium had detectable concentrations. 	<ul style="list-style-type: none"> • All levels of strontium in milk were similar to those resulting from worldwide fallout from nuclear weapons testing in the 1950s and 1960s. • Tritium was detected at concentrations similar to those in water and precipitation samples, and were consistent among boundary and distant locations. The tritium is likely from natural sources and worldwide fallout from nuclear weapons in the 1950s and 1960s.
<p>Game</p> <p>Three pronghorn antelope, two mule deer, three small fish, 27 waterfowl were collected and analyzed.</p>	<ul style="list-style-type: none"> • One pronghorn was found to have cesium in its muscle and liver. In addition, radioactive cobalt was detected in another pronghorn's liver. • Both mule deer contained detectable concentrations of cesium in muscle. One of the deer also had cesium in its liver and radioactive cobalt in its muscle. • The fish contained no man-made radionuclides. 	<ul style="list-style-type: none"> • Soil contaminated with cesium and radioactive cobalt is found around some INEL facilities, and game animals could possibly ingest these radionuclides. The concentrations in the pronghorn and mule deer were consistent with those found in sheep on- and offsite. • No INEL-related radionuclides were found in fish from the Big Lost River.

Radiological Surveillance Results for 1995, continued

Medium	What Was Found	What It Means
<p><i>Game</i>, continued</p>	<ul style="list-style-type: none"> Man-made radionuclides were detected in waterfowl from all five locations sampled, including a wetland distant from the INEL. Three birds taken at Test Area North contained above-background concentrations of cesium. 	<ul style="list-style-type: none"> Most concentrations represented background radiation, the source of which is natural processes and worldwide fallout. The waterfowl from Test Area North were collected from a pond known to have cesium in the underlying soil. A dose of 0.018 millirem was estimated if a person were to eat the entire edible portion of the most contaminated bird. That's 0.00005 percent of the average annual dose of 360 millirem for each person in southeastern Idaho.
<p><i>Lettuce</i></p> <p>Seven samples were collected and analyzed.</p>	<ul style="list-style-type: none"> Cesium was detected in two lettuce samples and strontium was detected in all samples. 	<ul style="list-style-type: none"> The maximum concentration of both cesium and strontium were found at the distant location of Blackfoot. The likely source of these man-made radionuclides is worldwide fallout from nuclear weapons testing in the 1950s and 1960s.
<p><i>Wheat</i></p> <p>10 wheat samples were collected and analyzed.</p>	<ul style="list-style-type: none"> Strontium was detected in seven wheat samples. 	<ul style="list-style-type: none"> The concentrations are within the range known to result from fallout from above-ground nuclear weapons testing of the 1950s and 1960s.
<p><i>Potatoes</i></p> <p>Five potato samples were collected and analyzed.</p>	<ul style="list-style-type: none"> Strontium was found in four of the potato samples. 	<ul style="list-style-type: none"> The concentrations are within the range known to result from fallout from above-ground nuclear weapons testing of the 1950s and 1960s.
<p><i>Sheep</i></p> <p>Six sheep were collected and analyzed (four that had grazed onsite and two that had grazed offsite).</p>	<ul style="list-style-type: none"> Cesium was detected in the muscle of three of four onsite sheep and one of two offsite sheep. 	<ul style="list-style-type: none"> All cesium concentrations were similar to those found previously in both onsite and offsite sheep samples previously. The radionuclide is likely due to worldwide fallout.

Nonradiological Results

Surveillance data indicated that particulate concentrations were greater at distant and boundary locations than on the INEL. Nitrogen dioxide and sulfur dioxide levels recorded on the INEL averaged less than five percent of Environmental Protection Agency standards. The primary source for particulates in the air on and around the INEL was considered to be soil blowing off farm fields. Data from IMPROVE samplers operated on the INEL and at Craters of the Moon National Monument were examined. Analyses on these samples provided information about the presence of 26 different elements in air samples. No substantial differences were noted for results between the two locations.

Concentrations of contaminants in liquid waste streams were found to comply with environmental laws and regulations. The largest INEL liquid waste stream, service waste from ICPP, was monitored monthly through sampling and analysis.

Testing of drinking water at facilities found coliform bacteria in samples 10 times during the year. Additional chlorination purified the water in each case. Regulatory standards were exceeded twice; the pH at TRA was 8.8 in June (standard is 8.5) and surfactants of 0.6 milligrams per liter were found at ICPP in October (standard is 0.5 milligrams per liter). Cleansing of organic chemicals from wells at TAN continued. These actions began in 1988. Some workers at TAN drink bottled water because of these contaminants.

USGS analyses found organic chemicals in previously known waste plumes beneath ICPP, NRF, RWMC, and TRA. Concentrations were similar to those previously reported.

Radiation Dose Estimates

Radiation from INEL operations was not detected by offsite environmental surveillance methods in 1995. This is usually the case. Because doses to the public are generally too small to be measured, computer models are used to estimate annual radiation doses from the INEL. Two models were used, and the higher dose estimate from INEL activities was 0.018 millirem. That's only 0.005 percent of an average person's annual dose from background sources. And, this is a dose for the "maximally exposed individual"—someone who spent the entire year living at a certain point near the INEL boundary, which for 1995 was at Frenchman's Cabin at the foot of Big Southern Butte.

The two models used each provide slightly different information. The first model used (CAP-88) is required by the Environmental Protection Agency for use at all DOE sites; whereas the second model (MESODIF) was created specifically for the INEL. The CAP-88 model resulted in a hypothetical maximum dose of 0.018 millirem. The MESODIF model produced an estimated dose of 0.008 millirem, occurring near Mud Lake. The dose estimates from these computer models can be compared to the average annual dose of 360 millirem in southeast Idaho.

A collective dose to the entire human population living within 50 miles of the center of the INEL is also calculated as part of MESODIF. This calculation considers all the pathways, the number of people in each locale, and the ways contaminants disperse from the INEL. The total potential population dose for the 121,500 people within 50 miles of the INEL's center was

0.08 person-rem, or 80 person-millirems. The largest person-rem for specific locales are in the Idaho Falls and Hamer census divisions. Idaho Falls has a relatively large population, whereas the Hamer division, which includes the communities of Hamer, Montevieu, Mud Lake, and Terreton, lies in the path of prevailing daytime winds. By comparison, background radiation exposure accounts for 42,525,000 person-millirems to the same population in southeastern Idaho.

Radiation Doses From Some Natural and Man-made Sources

Quality Assurance

In order to be sure that the INEL's environmental monitoring programs are getting accurate and reliable results, each organization maintains quality control and assurance programs.

Laboratories performing analyses for these programs also have quality assurance programs. The laboratories also participate in national performance evaluation programs that further show the high quality of their data.

Elements of a Quality Assurance Program

- Peer-reviewed procedures
- Documentation of program changes
- Calibration of instruments
- Equipment performance checks
- Independent audits
- Internal inspections
- Personnel training and evaluation
- Co-located samplers
- Sample tracking and accountability
- Analysis of duplicate and replicate samples
- Analysis of samples with no radiological contamination
- Analysis of samples with known amounts of contaminants
- Routine checks of the precision of radiological analyses