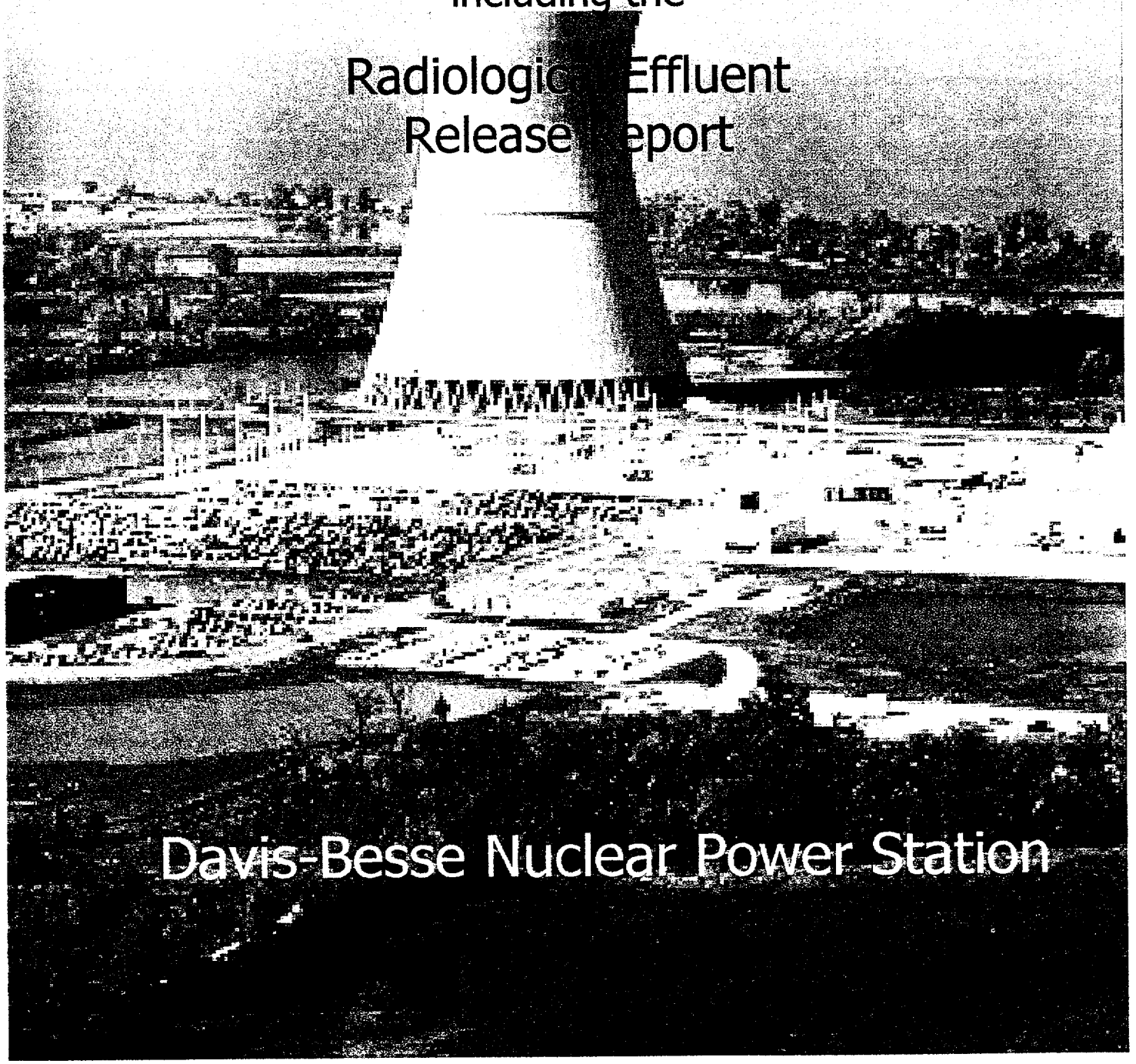
1999
Annual Radiological Environmental Operating Report

including the

Radiologic Effluent Release eport



Davis-Besse Nuclear Power Station

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

for

Davis-Besse Nuclear Power Station
January 1, 1999 through December 31, 1999

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Chemistry Section
Davis-Besse Nuclear Power Station

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Executive Summary

The Annual Radiological Environmental Operating Report (AREOR) is a detailed report on the Environmental Monitoring Programs conducted at the Davis-Besse Nuclear Power Station from January 1 through December 31, 1999. This report meets all of the requirements in Regulatory Guide 4.8, Davis-Besse Technical Specifications 6.9.1.10, and Davis-Besse Offsite Dose Calculation Manual (ODCM) Section 7.1. Reports included are the Radiological Environmental Monitoring Program, Land Use Census, and the Non-Radiological Environmental Programs, which consist of Meteorological Monitoring, Land and Wetland Management, Water Treatment, Chemical Waste Management, and Waste Minimization and Recycling. This report also includes the Radiological Effluent Release Report for the reporting period of January 1 through December 31, 1999.

Radiological Environmental Monitoring Program

The Radiological Environmental Monitoring Program (REMP) is established to monitor the radiological condition of the environment around Davis-Besse. The REMP is conducted in accordance with Regulatory Guide 4.8, Davis-Besse Technical Specification 6.8.4.d and the Davis-Besse ODCM Section 6.0. This program includes the sampling and analysis of environmental samples and evaluating the effects of releases of radioactivity on the environment.

Radiation levels and radioactivity have been monitored within a 25-mile radius around Davis-Besse since 1972. The REMP was established at Davis-Besse about five years before the Station became operational. This pre-operational sampling and analysis program provided data on radiation and radioactivity normally present in the area as natural background. Davis-Besse has continued to monitor the environment by sampling air, groundwater, milk, edible meat, fruit and vegetables, animal feed, soil, drinking water, surface water, fish, shoreline sediment, and by measuring radiation directly.

Samples are collected from indicator and control locations. Indicator locations are within approximately 5 miles of the site and are expected to show naturally occurring radioactivity plus any increases of radioactivity that might occur due to the operation of Davis-Besse. Control locations are farther away from the Station and are expected to indicate the presence of only naturally occurring radioactivity. The results obtained from the samples collected from indicator locations are compared with the results from those collected from control locations and with the concentrations present in the environment before Davis-Besse became operational. This allows for the assessment of any impact the operation of Davis-Besse might have had on the surrounding environment.

Approximately 1700 radiological environmental samples were collected and analyzed in 1999. An explanation for the sample program deviations for this reporting period is provided on page 37.

The results of the REMP indicate that Davis-Besse continues to be operated safely in accordance with applicable federal regulations. No measurable increase above background radiation or radioactivity is attributed to the operation of Davis-Besse.

The sampling results are divided into four sections: atmospheric monitoring, terrestrial monitoring, aquatic monitoring and direct radiation monitoring:

- Air is continuously being filtered at 10 locations, onsite and up to 25 miles away, and the filters are collected to monitor the atmosphere. The 1999 results are similar to those observed in preoperational and previous operational programs. Only background and fallout radioactivity normally present in the environment was detected and only at concentrations normal to the area.
- Terrestrial monitoring includes analysis of milk, ground water, meat, fruits, vegetables, animal feed and soil samples. Samples are collected onsite and up to 25 miles away depending on the type of sample. The results of the analyses of the terrestrial samples indicate concentrations of radioactivity similar to previous years and indicates no build-up of radioactivity due to the operation of Davis-Besse.
- Aquatic monitoring includes the collection and analysis of drinking water, untreated surface water, fish and shoreline sediments from onsite and the vicinity of Lake Erie. The 1999 results of analysis for fish, untreated surface water, drinking water and shoreline sediment indicate normal background concentration of radionuclides and show no increase or build-up of radioactivity due to the operation of Davis-Besse.
- Direct radiation averaged 14 mrem/91days at indicator locations and 15.1 mrem/91 days at control locations. This is similar to results of previous years.

The operation of Davis-Besse in 1999 caused no significant increase in the concentrations of radionuclides in the environment and no adverse effect on the quality of the environment. Radioactivity released in the Station's effluents was well below the applicable federal regulatory limits. The estimated radiation dose to the general public due to the operation of Davis-Besse in 1999 was well below all applicable regulatory limits.

In order to estimate radiation dose to the public, the pathways through which public exposure can occur must be known. To identify these exposure pathways, an Annual Land Use Census is performed as part of the REMP. During the census, Davis-Besse personnel travel every public road within a five mile radius of the Station to locate the radiological exposure pathways (e.g., residences, vegetable gardens, milk cows/goats, etc.). The one pathway of particular interest is the pathway that, for a specific radionuclide, provides the greatest dose to a sector of the population. This is called the critical pathway. The critical pathway for 1999 is a garden in the West sector, 1540 meters from Davis-Besse.

Radiological Effluent Release Report

The Radiological Effluent Release Report (RERR) is a detailed listing of radioactivity released from the Davis-Besse Nuclear Power Station during the period January 1, 1999 through December 31, 1999. The doses due to radioactivity released during this period were estimated to be:

Liquid Effluents:

Maximum Individual Whole Body Dose	1.25E-01 mrem (0.1250 mrem)
Maximum Individual Significant Organ Dose	1.35E-01 mrem (0.1350 mrem)
Total Integrated Population Dose	1.23E+00 person-rem (1.2300 person-rem)
Average Dose to the Individual	5.64E-04 mrem (0.000564 mrem)

Gaseous Effluents:

Maximum Individual Whole Body Dose due to I-131, H-3 and Particulates with half-lives greater than 8 days	1.52E 03 mrem (0.00152 mrem)
Maximum Significant Organ Dose due to I-131, H-3 and Particulates with half-lives greater than 8 days	8.86E-03 mrem (0.00886 mrem)
Total Integrated Population Dose due to I-131, H-3 and Particulates with half-lives greater than 8 days	1.14E-02 person-rem (0.0114 person-rem)
Average Dose to an Individual in the population due to I-131, H-3 and Particulates with half-lives greater than 8 days	5.23E-06 mrem (0.00000523 mrem)
Maximum Individual Skin Dose due to noble gases	7.10E-03 mrad (0.00710 mrad)
Maximum Individual Whole Body Dose due to noble gases	1.76E-03mrad (0.00176 mrad)
Total Integrated Population Dose due to noble gases	3.71-03 person-rem (0.00371 person-rem)
Average Dose to individual in population due to noble gases	1.70E-06 mrem (0.00000170 mrem)

These doses represent an extremely small fraction of the limits set by the NRC or the limits set in the ODCM.

The abnormal gaseous releases during this reporting period are listed on page 89.

There was one change to the Process Control Program (PCP) and one change to the ODCM during this reporting period.

Non-Radiological Environmental Programs

Meteorological Monitoring

The Meteorological Monitoring Program at Davis-Besse is part of a program for evaluating the radiological effects of the routine operation of Davis-Besse on the surrounding environment. Meteorological monitoring began in October, 1968.

Meteorological data recorded at Davis-Besse include wind speed, wind direction, sigma theta (standard deviation of wind direction), ambient temperature, differential temperature, dew point and precipitation. Two instrument-equipped meteorological towers are used to collect data. Data recovery for the five instruments required to be operational by Davis-Besse Technical Requirement Manual was 98.6%.

Marsh Management

Toledo Edison and the Cleveland Electric Illuminating Company co-own the Navarre Marsh which they lease to the U.S. Fish and Wildlife Service, who manage it as part of the Ottawa National Wildlife Refuge.

Special projects conducted in 1999 with the cooperation of Ohio Department of Natural Resources included Canada goose banding and a Volunteer Eagle Watcher Workshop. Davis-Besse hosted the fifth annual Federal Junior Duck Stamp Art Contest for the State of Ohio in cooperation with the Ottawa National Wildlife Refuge.

A pair of American Bald Eagles used the nest platform that was built in 1996 but failed to produce any young.

Water Treatment

Davis-Besse uses Lake Erie as a source of water for its Water Treatment Plant. The water is treated onsite to produce high purity water for use in the Station's cooling systems.

Since December 1, 1998, domestic water needs at Davis-Besse have been met by the Carroll Township Water Treatment Plant.

Sewage is treated onsite at the Davis-Besse Waste Water Treatment Plant (WWTP). The sewage is processed and then pumped to a basin where further reduction in solid content takes place. Following a settling period, the water is discharged, along with other station waste water, back to Lake Erie.

Chemical Waste Management

The Chemical Waste Management Program at Davis-Besse was developed to ensure that the off-site disposal of non-radioactive hazardous and nonhazardous chemical wastes is performed in accordance with all applicable state and federal regulations. Chemical waste disposal vendors contracted by Davis-Besse use advanced technology for offsite disposal of chemical wastes in order to protect human health and the environment.

In 1999, the Davis-Besse Nuclear Power Station maintained small quantity generator status, generating 6250 pounds of hazardous waste. Davis-Besse personnel also continuously strive to identify alternate ways to reduce hazardous waste generation. There were 3000 gallons of non-hazardous waste oil generated in 1999. Approximately 550 gallons of oil filters and solid oily debris were also generated. Additionally 310 gallons of other chemicals such as microfilm process chemicals and resins were generated in 1999.

As required by Superfund Amendment and Reauthorization Act (SARA), Davis-Besse reported hazardous products and chemicals to local fire departments and local and state planning commissions. As part of the program to remove PCB fluid from Davis-Besse, all electrical transformers have been retrofilled and reclassified as non-PCB transformers.

Waste Minimization and Recycling

The Waste Minimization and Recycling Program at Davis-Besse began in 1991 with the collection and recycling of paper. This program was expanded and reinforced during 1993 to include the recycling of paper, aluminum cans, cardboard, and metal. Paper and cardboard recycling typically exceeds 50 tons annually. The scrap metal collected onsite is sold to scrap companies.

Appendices

Appendix A contains results from the Interlaboratory Comparison Program required by Davis-Besse Technical Specifications. Samples with known concentrations of radioisotopes are prepared by the Environmental Protection Agency (EPA), and then sent (with information on sample type and date of collection only) to the laboratory contracted by the Davis-Besse Nuclear Power Station to analyze its REMP samples. The results are then checked by the EPA to ensure consistency with the known values. The results from both the contracted laboratory and the EPA are provided in Appendix A.

Appendix B contains data reporting conversions used in the REMP at Davis-Besse. The appendix provides an explanation of the format and computational methods used in reporting REMP data. Information on counting uncertainties and the calculations of averages and standard deviations is also provided.

Appendix C lists the effluent concentration limits for alpha and beta emitting radioisotopes and for certain other radioisotopes in air and water samples. These concentrations are taken directly from the Code of Federal Regulations, and provide comparison values for actual REMP sampling results for 1999.

Appendix D provides a REMP sampling summary from 1999. The appendix provides a listing of the following for each sample type:

- the number and types of analyses performed,
- the lower limit of detection for each analysis,
- the mean and range of results for control and indicator locations,
- the mean, range, and location description for the location with the highest annual mean,
- the number of non-routine results.

For detailed studies, Appendix D provides more specific information than that listed in Chapter 2 of this report. The information presented in Appendices A through D was provided by Teledyne Isotopes Midwest Laboratories in their Final Progress Report to Toledo Edison (February 2000).

Introduction

Introduction

Coal, oil, natural gas and hydropower are used to run this nation's electric generating stations; however, each method has its drawbacks. Coal-fired power can affect the environment through mining, acid rain and air pollution. Oil and natural gas are in limited supply and are therefore costly, and hydropower is limited due to the environmental impact of damming our waterways and the scarcity of suitable sites in our country.

Nuclear energy provides an alternate source of energy, which is readily available. The operation of nuclear power stations has a very small impact on the environment. In fact, the Davis-Besse Nuclear Power Station is surrounded by hundreds of acres of marshland, which make up part of the Ottawa National Wildlife Refuge, the only national refuge in Ohio. In order to more fully understand this unique source of energy, background information on basic radiation characteristics, risk assessment, reactor operation and effluent control is provided in this section.

Fundamentals

The Atom

All matter consists of **atoms**. Simply described, atoms are made up of positively and negatively charged particles, and particles which are neutral. These particles are called **protons, electrons,** and **neutrons,** respectively (Figure 1). The relatively large protons and neutrons are packed tightly together in a cluster at the center of the atom called the **nucleus**. Orbiting around this nucleus are one or more smaller electrons. In an electrically neutral atom the negative charges of the electrons are balanced by the positive charges of the protons. Due to their dissimilar charges, the protons and electrons have a strong attraction for each other, which helps hold the atom together. Other attractive forces between the protons and neutrons keep the densely packed protons from repelling each other, preventing the nucleus from breaking apart.

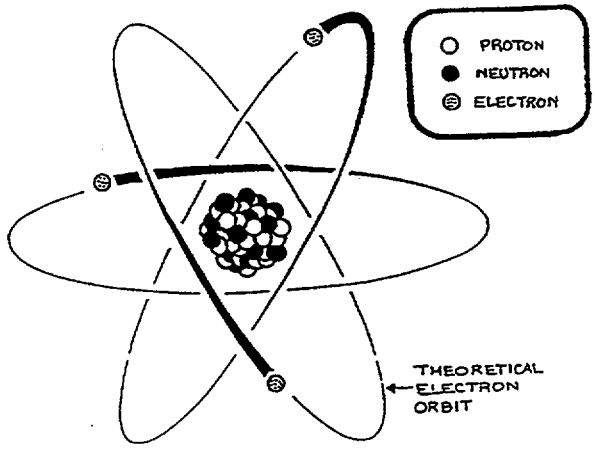

Figure 1: An atom consists of two parts: a nucleus containing positively charged protons and electrically neutral neutrons and one or more negatively charged electrons orbiting the nucleus. Protons and neutrons are nearly identical in size and weight, while each is about 2000 times heavier than an electron.

Radiation and Radioactivity

Isotopes and Radionuclides

A group of identical atoms, containing the same number of protons, make up an **element.** In fact, the number of protons an atom contains determines its chemical identity. For instance, all atoms with one proton are hydrogen atoms and all atoms with eight protons are oxygen atoms. However, the number of neutrons in the nucleus of an element may vary. Atoms with the same number of protons, but different numbers of neutrons are called **isotopes.** Different isotopes of the same element have the same chemical properties and many are stable or nonradioactive. An unstable or radioactive isotope of an element is called a **radioisotope, radioactive atom, or radionuclide**. Radionuclides usually contain an excess amount of energy in the nucleus. The excess energy is usually due to a surplus or deficit in the number of neutrons in the nucleus. Radionuclides can be naturally occurring such as uranium-238, beryllium-7 and potassium-40, or man-made, such as iodine-131, cesium-137, and cobalt-60.

Radiation

Radiation is simply the conveyance of energy through space. For instance, heat emanating from a stove is a form of radiation, as are light rays, microwaves, and radio waves. **Ionizing radiation** is another type of radiation and has similar properties to those of the examples listed above. Ionizing radiation consists of both **electromagnetic radiation** and **particulate radiation**. Electromagnetic radiation is energy with no measurable mass that travels with a wave-like motion through space. Included in this category are **gamma rays** and **X-rays**. Particulate radiation consists of tiny, fast moving particles which, if unhindered, travel in a straight line through space. The three types of particulate radiation of concern to us are **alpha particles,** made up of 2 protons and 2 neutrons; **beta particles**, which are essentially free electrons (electrons not attached to an atom); and **neutrons**. The properties of these types of radiation will be described more fully in the Range and Shielding section.

Radioactive Decay

Radioactive atoms attempt to reach a stable, non-radioactive state through a process known as **radioactive decay**. Radioactive decay is the release of energy from an atom through the emission of ionizing radiation. Radioactive atoms may decay directly to a stable state or may go through a series of decay stages, called a **radioactive decay series**, and produce several **daughter products** which eventually result in a stable atom. The loss of energy and/or matter through radioactive decay may transform the atom into a chemically different element. For example, when uranium-238 decays, it emits an alpha particle and, as a result, the atom loses 2 protons and 2 neutrons. As discussed previously, the number of protons in the nucleus of an atom determines its chemical identity. Therefore, when the uranium-238 atom loses the 2 protons and 2 neutrons, it is transformed into an atom of thorium-234. Thorium-234 is one of the 14 successive daughter products of uranium-238. Radon is another daughter product, and the series ends with stable lead-206.

This example is part of a known radioactive decay series, called the uranium series, which begins with uranium-238 and ends with lead-206 (Figure 2).

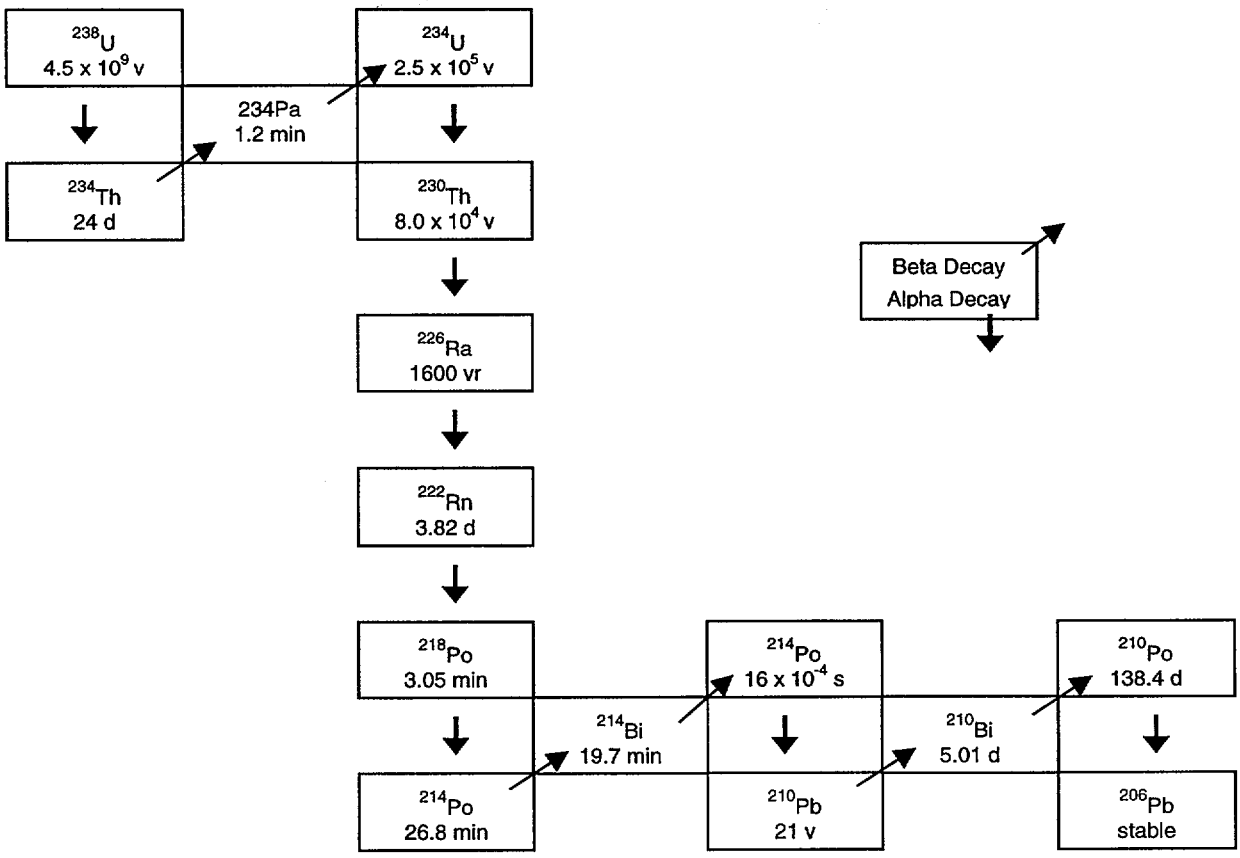

Figure 2: Principle Decay Scheme of the Uranium Series.

Half-life

Most radionuclides vary greatly in the frequency with which their atoms release radiation. Some radioactive materials, in which there are only infrequent emissions, tend to have a very long half-lives. Those radioactive materials that are very active, emitting radiation more frequently, tend to have comparably short half-lives. The length of time an atom remains radioactive is defined in terms of **half-lives**. Half-life is the amount of time required for a radioactive substance to lose half its activity through the process of radioactive decay. Half-lives vary from millionths of a second to millions of years.

Interaction with Matter

Ionization

Through interactions with atoms, alpha, beta, and gamma radiation lose their energy. When these forms of radiation interact with any form of material, the energy they impart may cause

atoms in that material to become **ions**, or charged particles. Normally, an atom has the same number of protons as electrons. Thus, the number of positive and negative charges cancel, and the atom is electrically neutral. When one or more electrons are removed an ion is formed. Ionization is one of the processes which may result in damage to biological systems.

Range and Shielding

Particulate and electromagnetic radiation each travel through matter differently because of their different properties. Alpha particles contain 2 protons and 2 neutrons, are relatively large, and carry an electrical charge of +2. Alpha particles are ejected from the nucleus of a radioactive atom at speeds ranging from 2,000 to 20,000 miles per second. However, due to its comparatively large size, an alpha particle usually does not travel very far before it loses most of its energy through collisions and other interactions with atoms. As a result, alpha particles can easily be stopped by a sheet of paper or a few centimeters of air (Figure 3).

Beta particles are very small, and comparatively fast particles, traveling at speeds near the speed of light (186,000 miles per second). Beta particles have an electrical charge of either +1 or -1. Because they are so small and have a low charge, they do not collide and interact as often as alpha particles, so they can travel farther. Beta particles can usually travel through several meters of air, but may be stopped by a thin piece of metal or wood.

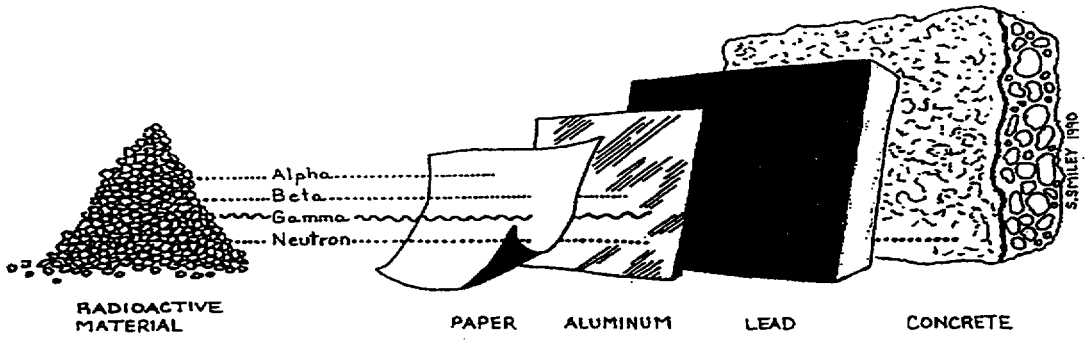

Figure 3: As radiation travels, it collides and interacts with other atoms and loses energy. Alpha particles can be stopped by a sheet of paper, and beta particles by a thin sheet of aluminum. Gamma radiation is shielded by highly dense materials such as lead, while hydrogenous materials (those containing hydrogen atoms), such as water and concrete, are used to stop neutrons.

Gamma rays are pure energy and travel at the speed of light. They have no measurable charge or mass, and generally travel much farther than alpha or beta particles before being absorbed. After repeated interactions, the gamma ray finally loses all of its energy and vanishes. The range of a gamma ray in air varies, depending on the ray's energy and interactions. Very high energy gamma radiation can travel a considerable distance, whereas low energy gamma radiation may travel only a few feet in air. Lead is used as shielding material for gamma radiation because of its density. Several inches of lead or concrete may be needed to effectively shield gamma rays.

Neutrons come from several sources, including the interactions of cosmic radiation with the earth's atmosphere and nuclear reactions within operating nuclear power reactors. However, neutrons are not of environmental concern since the neutron source at nuclear power stations is sealed within the containment building.

Because neutrons have no charge, they are able to pass very close to the nuclei of the material through which they are traveling. As a result, neutrons may be captured by one of these nuclei or they may be deflected. When deflected, the neutron loses some of its energy. After a series of these deflections, the neutron has lost most of its energy. At this point, the neutron moves about as slowly as the atoms of the material through which it is traveling, and is called a **thermal neutron**. In comparison, fast neutrons are much more energetic than thermal neutrons and have greater potential for causing damage to the material through which they travel. Fast neutrons can have from 200 thousand to 200 million times the energy of thermal neutrons.

Neutron shielding is designed to slow fast neutrons and absorb thermal neutrons. Neutron shielding materials commonly used to slow neutrons down are water or polyethylene. The shield is then completed with a material such as cadmium, to absorb the now thermal neutrons. At Davis-Besse, concrete is used to form an effective neutron shield because it contains water molecules and can be easily molded around odd shapes.

Quantities and Units of Measurement

There are several quantities and units of measurement used to describe radioactivity and its effects. Three terms of particular usefulness are **activity, absorbed dose**, and **dose equivalent**.

Activity: Curie

Activity is the number of atoms in a sample that disintegrate (decay) per unit of time. Each time an atom disintegrates, radiation is emitted. The **curie** (Ci) is the unit used to describe the activity of a material and indicates the rate at which the atoms of a radioactive substance are decaying. One curie indicates the disintegration of 37 billion atoms per second.

A curie is a unit of activity, not a quantity of material. Thus, the amount of material required to produce one curie varies. For example, one gram (1/28 th of an ounce) of radium-226 is the equivalent of one curie of activity, but it would take 9,170,000 grams (about 10 tons) of thorium-232 to equal one curie.

Smaller units of the curie are often used, especially when discussing the low concentrations of radioactivity detected in environmental samples. For instance, the microcurie (uCi) is equal to one millionth of a curie, while the picocurie (pCi) represents one trillionth of a curie.

Absorbed Dose: Rad

Absorbed dose is a term used to describe the radiation energy absorbed by any material exposed to ionizing radiation, and can be used for both particulate and electromagnetic radiation. The

Rad (radiation absorbed dose) is the unit used to measure the absorbed dose. It is defined as the energy of ionizing radiation deposited per gram of absorbing material (1 Rad = 100 erg/gm). The rate of absorbed dose is usually given in Rad/hr.

If the biological effect of radiation was directly proportional to the energy deposited by radiation in an organism, the Rad would be a suitable measurement of the biological effect. However, biological effects depend not only on the total energy deposited per gram of tissue, but on how this energy is distributed along its path. Experiments have shown that some types of radiation are more damaging per unit path of travel than others. Thus, another unit is needed to quantify the biological damage caused by ionizing radiation.

Dose Equivalent: Rem

Biological damage due to alpha, beta, gamma and neutron radiation may result from the ionization caused by these radiation's. Some types of radiation, especially alpha particles which cause dense local ionization, can result in up to 20 times the amount of biological damage for the same energy imparted as do gamma or X-rays. Therefore, a **quality factor** must be applied to account for the different ionizing capabilities of various types of ionizing radiation. When the quality factor is multiplied by the absorbed dose, the result is the **dose equivalent**, which is an estimate of the possible biological damage resulting from exposure to a particular type of ionizing radiation. The dose equivalent is measured in **rem (radiation equivalent man)**.

An example of this conversion from absorbed dose to dose equivalent uses the quality factor for alpha radiation, which is 20. Thus, 1 Rad of alpha radiation is approximately equal to 20 rem. Beta and gamma radiation each have a quality factor of 1, therefore one Rad of either beta or gamma radiation is approximately equal to one rem. Neutrons have a quality factor ranging from 2 to 10. One rem produces the same amount of biological damage, regardless of the source. In terms of radiation, the rem is a relatively large unit. Therefore, a smaller unit, the **millirem**, is often used. One millirem (mrem) is equal to 1/1000 of a rem.

Deep Dose Equivalent (DDE)

Deep dose equivalent is the measurement of dose within the body, from sources of radiation that are external to the body. It is what is measured and recorded Thermoluminescent dosimeters (TLDs), film badges, or other dosimeters. For example, at Davis-Besse or at any hospital that has x-ray equipment, you will see people wearing these devices. These instruments are worn to measure DDE.

Committed Effective Dose Equivalent (CEDE)

Committed effective dose equivalent is a measure of the dose received from any radioactive material taken into the body. It is calculated from the sum of the products of the committed dose equivalent to the organ or tissue multiplied by the organ or tissue weighting factor. CEDE accounts for all of the dose delivered during the entire time the radioactive material is in the body.

Total Effective Dose Equivalent (TEDE)

Total effective dose equivalent means the sum of the deep dose equivalent (for dose from sources external to the body) and the committed effective dose equivalent (for internal dose). As these are both doses to the body, they are not tracked separately. The NRC limits occupational dose to a radiation worker to five rem (5000 mrem) TEDE per year.

Sources of Radiation

Background Radiation

Radiation is not a new creation of the nuclear power industry; it is a natural occurrence on the earth. It is probably the most "natural" thing in nature. Mankind has always lived with radiation and always will. In fact, during every second of life, over 7,000 atoms undergo radioactive decay "naturally" in the body of the average adult. In addition, radioactive decay also occurs naturally in soil, water, air, and space. All these common sources of radiation contribute to the natural background radiation to which everyone is exposed.

The earth is constantly showered by a steady stream of high energy gamma rays and particulate radiation that come from space, known as cosmic radiation. The atmosphere shields us from most of this radiation, but everyone still receives about 20 to 50 mrem each year from this source. The thinner air at higher altitudes provides less protection against cosmic radiation. So people living at higher altitudes or flying in an airplane are exposed to more cosmic radiation. Radionuclides commonly found in the atmosphere as a result of cosmic ray interactions include beryllium-7, carbon-14, tritium (H-3), and sodium-22.

Another common, naturally occurring radionuclide is potassium-40. About one-third of the external and internal dose from naturally occurring background radiation is attributed to this radioactive isotope of potassium.

The major source of background radiation is radon, a colorless, odorless, radioactive gas that results from the decay of radium-226, a member of the uranium-238 decay series. Since uranium occurs naturally in all soils and rocks, everyone is continuously exposed to radon and its daughter products. Radon would not be considered to pose a health hazard unless it is concentrated in a confined area, such as buildings, basements or underground mines. Radon-related health concerns stem from the exposure of the lungs to this radioactive gas. Radon emits alpha radiation when it decays, this could cause damage to internal tissues when inhaled. As a result, exposure to the lungs is of concern, as the only recognized health effect associated with exposure to radon is an increased risk of lung cancer. This effect has been seen when the radon is present at levels common in uranium mines. According to the National Council on Radiation Protection and Measurement (NCRP), over half of the radiation dose the average American receives is attributed to radon.

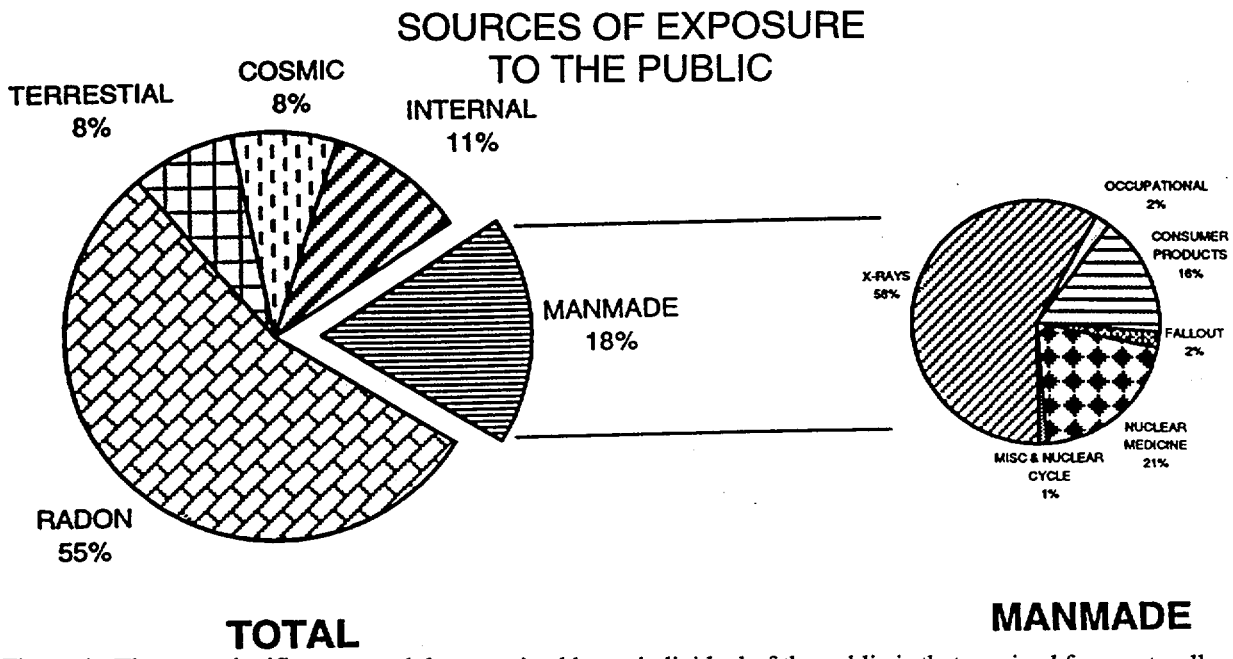

Figure 4: The most significant annual dose received by an individual of the public is that received from naturally occurring radon. A very small annual dose to the public results from producing electricity by nuclear power.

Further information on radon, its measurement, and actions to reduce the radon concentration in buildings can be obtained by contacting the state radon program office at the following address:

Radiological Health Program
Ohio Department of Health
P.O. Box 118
Columbus, Ohio 43266-0118
(614) 481-5800
(800) 523-4439 (in Ohio Only)

The approximate average background radiation in this area (see Figure 4) is 300 mrem/year.

Man-Made Radiation

In addition to naturally occurring cosmic radiation and radiation from naturally occurring radioactivity, people are also exposed to man-made radiation. The largest sources of exposure include medical x-rays and radioactive pharmaceuticals. Small doses are also received from consumer products such as televisions, smoke detectors, and fertilizers. Fallout from nuclear weapons tests is another source of man-made exposure. Fallout radionuclides include strontium-90, cesium-137, and tritium. Less than one percent of the annual dose a member of the public receives is a result of having electricity generated by nuclear power.

Health Effects of Radiation

The effects of ionizing radiation on human health have been under study for more than 80 years. Scientists have obtained valuable knowledge through the study of laboratory animals that were exposed to radiation under extremely controlled conditions. However, it has been difficult to relate the biological effects of irradiated laboratory animals to the potential health effects on humans.

The effects of radiation on humans can be divided into two categories, somatic and genetic. Somatic effects are those which develop in the directly exposed individual, including a developing fetus. Genetic effects are those which are observed in the offspring of the exposed individual.

Somatic effects can be divided further into acute and chronic effects. Acute effects develop shortly after exposure to large amount of radiation. Much study has been done with human populations that were exposed to ionizing radiation under various circumstances. These groups include the survivors of the atomic bomb, persons undergoing medical radiation treatment, and early radiologists, who accumulated large doses of radiation, unaware of the potential hazards.

Chronic effects are a result of exposure to radiation over an extended period of time. Examples of such groups are clock dial painters, who ingested large amounts of radium by "tipping" the paint brushes with their lips, and uranium miners, who inhaled large amounts of radioactive dust while mining pitchblende (uranium ore). The studies performed on these groups have increased our knowledge of the health effects from comparatively very large doses of radiation received over long periods of time.

Continuous exposure to low levels of radiation may produce somatic changes over an extended period of time. For example, someone may develop cancer from man-made radiation, background radiation, or some other source not related to radiation. Because all illnesses caused by low level radiation can also be caused by other factors, it is virtually impossible to determine individual health effects of low level radiation. Even though no effects have been observed at doses less than 50 rem, to be conservative, we assume the health effects resulting from low doses of radiation occur proportionally to those observed following large doses of radiation. Most radiation scientists agree that this assumption over-estimates the risks associated with a low level radiation exposure. The effects predicted in this manner have never been actually observed in any individuals exposed to low level radiation. Therefore, the most likely somatic effect of low level radiation is believed to be a small increased risk of cancer.

Genetic effects could occur as a result of ionizing radiation interacting with the genes in the human cells. Radiation (as well as common chemicals) can cause physical changes or mutations in the genes. Chromosome fibers can break and rearrange, causing interference with the normal cell division of the chromosome by affecting their number and structure. A cell is able to rejoin the ends of a broken chromosome, but if there are two breaks close enough together in space and time, the broken ends from one break could join incorrectly with those from another. This could cause translocations, inversions, rings, and other types of structural rearrangements. When this

happens, new mutated genes are created. Radiation is not the only mechanism by which such changes can occur. Spontaneous mutations and chemically induced mutations also have been observed. These mutated genes may be passed from parent to offspring. Viable mutations due to low level, low dose radiation have not been observed in humans.

Health Risks

While people may accept the risks inherent in their personal activities, such as smoking and driving to work each day, they are less inclined to accept the risk inherent in producing electricity. As with any industrial environment, it is not possible to guarantee a risk free environment. Thus, attention should be focused on taking steps to safeguard the public, on developing a realistic assessment of the risks, and on placing these risks in perspective. The perceptions of risk associated with exposure to radiation has, perhaps, the greatest misunderstanding. Because people may not understand ionizing radiation and its associated risks, they may fear it. This fear is compounded by the fact that we cannot hear, smell, taste or feel ionizing radiation.

However, we do not fear other potentially hazardous things for which we have the same lack of sensory perception, such as radio waves, carbon monoxide, and small concentrations of numerous cancer causing substances. These risks are larger and measurable compared to those presumed to be associated with exposure to low level, low dose radiation. Most of these risks are with us throughout our lives, and can be added up over a lifetime to obtain a total effect. Table 1 shows a number of different factors that decrease the average life expectancy of individuals in the United States.

Table 1: Risk Factors: Estimated Decrease in Average Life Expectancy

Overweight by 30% :		3.6 years
Cigarette smoking: :	1 pack/day	7.0 years
	2 packs/day	10.0 years
Heart diseases :		5.8 years
Cancer :		2.7 years
City Living (not rural) :		5.0 years
All operating commercial nuclear power plants totaled :		less than 12 minutes

Benefits of Nuclear Power

Nuclear power plays an important part in meeting today's electricity needs, and will continue to serve as an important source of electric energy well into the future. Today more than twenty percent of the electricity produced in the United States is from nuclear powered electrical generating stations.

Nuclear power offers several advantages over alternative sources of electric energy:

- nuclear power has an excellent safety record dating back to 1957 when the first commercial nuclear power station began operating,
- uranium, the fuel for nuclear power stations, is a relatively inexpensive fuel that is readily available in the United States,
- nuclear power is the cleanest energy source for power stations that use steam to produce electricity. There are no "greenhouse" gases or acid gases produced when using nuclear fuel.

The following sections provide information on the fundamentals of how Davis-Besse uses nuclear fuel and the fission process to produce electricity.

Nuclear Power Production

Electricity is produced in a nuclear power station in the same way as in a fossil-fueled station with the exception of the source of heat. Heat changes water to steam that turns a turbine. In a fossil-fueled station, the fuel is burned in a furnace, which is also a boiler. Inside the boiler, water is turned into steam. In a nuclear station, the furnace is replaced by a reactor containing a core of nuclear fuel, primarily uranium. Heat is produced when the atoms of uranium are split, or fissioned, inside the reactor.

What is Fission?

A special force called the binding force holds the protons and neutrons together in the nucleus of the atom. The strength of this binding force varies from atom to atom. If the bond is weak enough, the nucleus can be split when bombarded by a free neutron (Figure 5). This causes the entire atom to split, producing smaller atoms, more free neutrons, and heat. In a nuclear reactor, a chain reaction of fission events provides the heat necessary to boil the water to produce steam.

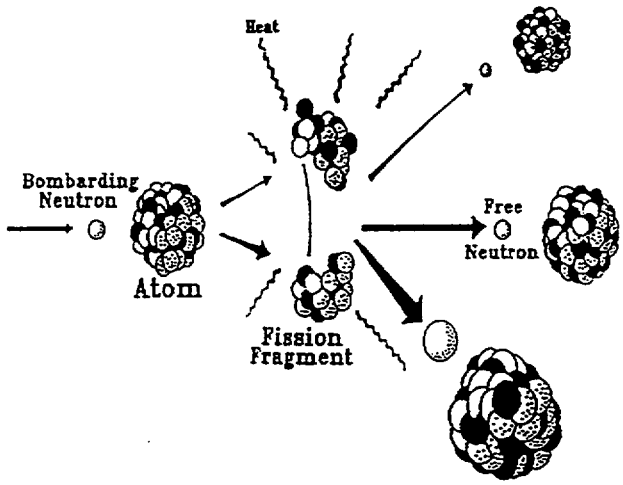

Figure 5: When a heavy atom, such as uranium-235 is split or fissioned, heat, free neutrons, and fission fragments result. The free neutrons can then strike neighboring atoms causing them to fission also. In the proper environment, this process can continue indefinitely in a chain reaction.

Nuclear Fuel

The fissioning of one uranium atom releases approximately 50 million times more energy than the combustion of a single carbon atom common to all fossil fuels. Since a single small reactor fuel pellet contains trillions of atoms, each pellet can release an extremely large amount of energy. The amount of electricity that can be generated from three small fuel pellets would require about 3.5 tons of coal or 12 barrels of oil to generate.

Nuclear fission occurs spontaneously in nature, but these natural occurrences cannot sustain themselves because the freed neutrons either are absorbed by non-fissionable atoms or quickly **decay**. In contrast, a nuclear reactor minimizes neutron losses, thus sustaining the fission process by several means:

- using fuel that is free of impurities that might absorb the free neutrons,
- enriching the concentration of the rarer fissionable isotope of uranium (U-235) relative to the concentration of U-238, a more common isotope that does not fission easily,
- slowing neutrons down by providing a "moderator" such as water to increase the probability of fission.

Natural uranium contains less than one percent U-235 compared to the more abundant U-238 when it's mined. Before it can be economically used in a reactor, it is enriched to three to five percent U-235, in contrast to nuclear material used in nuclear weapons which is enriched to over 97 percent. Because of the low levels of U-235 in nuclear fuel, a nuclear power station **cannot** explode like a bomb.

After the uranium ore is separated from the earth and rock, it is concentrated by a milling process. After milling the ore to a granular form and dissolving out the uranium with acid, the uranium is converted to **uranium hexafluoride (UF_6)**. UF_6 is a chemical form of uranium that exists as a gas at temperatures slightly above room temperature. The UF_6 is then highly purified and shipped to an enrichment facility where **gaseous diffusion converters** increase the concentration of U-235. The enriched gaseous UF_6 is then converted into powdered **uranium dioxide (UO_2)**, a highly stable ceramic material. The UO_2 powder is put under high pressure to form **fuel pellets**, each about 5/8 inch long and 3/8 inch in diameter . Approximately five pounds of these pellets are placed into a 12 foot long metal tube made of zirconium alloy. The tubes constitute the **fuel cladding**. The fuel cladding is highly resistant to heat, radiation, and corrosion. When the tubes are filled with fuel pellets, they are called **fuel rods**.

The Reactor Core

Two hundred eight fuel rods comprise a single **fuel assembly**. The **reactor core** at Davis-Besse contains 177 of these fuel assemblies, each approximately 14 feet tall and 2,000 pounds in weight. In addition to the fuel rods, the fuel assembly also contains 16 vacant holes for the insertion of **control rods**, and one vacant hole for an **incore monitoring probe**. This probe monitors temperature and neutron levels in the fuel assembly. The Davis-Besse reactor vessel, which contains all the fuel assemblies, weighs 838,000 pounds, has a diameter of 14 feet, is 39 feet high, and has 8 1/2 inch thick steel walls.

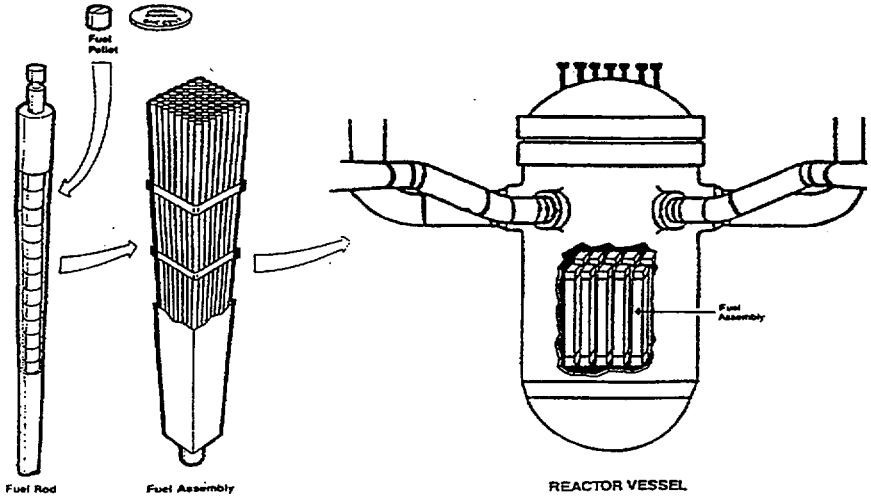

Figure 6: The reactor core at Davis-Besse contains 177 fuel assemblies. Each assembly contains 208 fuel rods. Each fuel rod is filled with approximately five pounds of fuel pellets, each pellet is approximately 3/8 inch in diameter and 5/8 inch long.

Fission Control

The fission rate inside the reactor core is controlled by raising or lowering **control rod assemblies** into the reactor core. Each assembly consist of "fingers" containing silver, indium, and cadmium metals that absorb free neutrons, thus disrupting the fission chain reaction. When control rod assemblies are slowly withdrawn from the core, fissioning begins and heat is produced. If the control rod assemblies are inserted rapidly into the reactor core, as during a plant "trip", the chain reaction ceases. A slower acting (but more evenly distributed) method of fission control is achieved by the addition of a **neutron poison** to the reactor coolant water. At Davis-Besse, high purity boric acid is concentrated or diluted in the coolant to achieve the desired level of fission. Boron-10 readily absorbs free neutrons, forming boron-11, removing the absorbed neutrons from the chain reaction.

Reactor Types

Virtually all of the commercial reactors in this country are either **boiling water reactors (BWRs)** or **pressurized water reactors (PWRs)**. Both types are also called **light water reactors (LWRs)** because their coolant, or medium to transfer heat, is ordinary water, which contains the light isotope of hydrogen. Some reactors use the heavy isotope of hydrogen (deuterium) in the reactor coolant. Such reactors are called **heavy water reactors (HWRs)**.

In BWRs, water passes through the core and boils into steam. The steam passes through separators which remove water droplets. The steam then travels to dryers before entering the turbine. After passing though the turbine the steam is condensed back into water and returns to the core to repeat the cycle.

In PWRs, the reactor water or coolant is pressurized to prevent it from boiling. The reactor water is then pumped to a **steam generator** (heat exchanger) where its heat is transferred to a secondary water supply. The secondary water inside the generator boils into steam which is then used to turn the turbine. This steam is then condensed back into water and returned to the steam generator. Davis-Besse uses a PWR design.

The following paragraphs describe the various systems illustrated in Figure 7. Major systems in the Davis-Besse Station are assigned a different color in the figure.

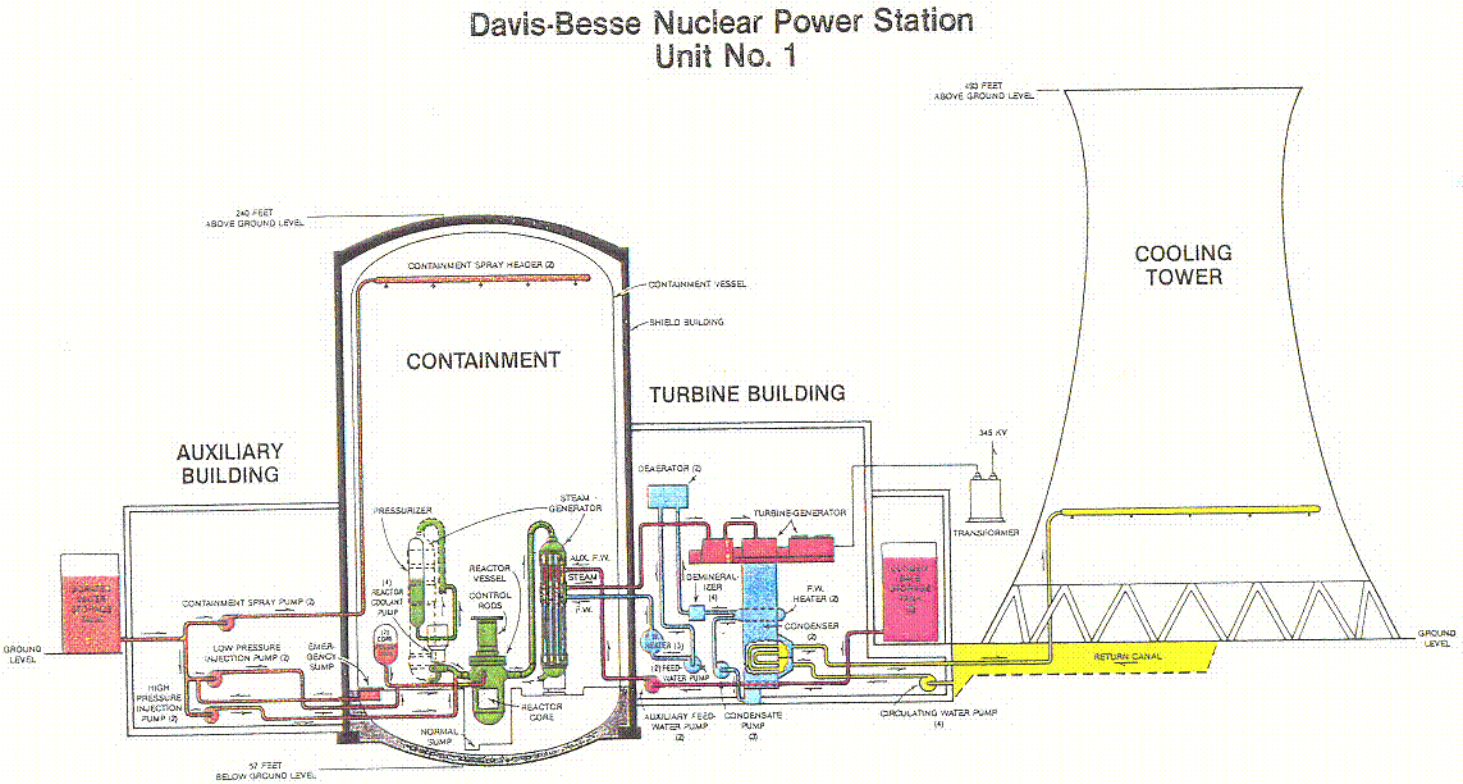

Figure 7: Station Systems

C-1

Station Systems

Containment Building and Fission Product Release Barriers

The **containment building** houses the reactor vessel, the pressurizer, two steam generators, the reactor coolant pumps and reactor coolant system piping. The building is constructed of an inner 1 –1/2 inch thick steel liner or **containment vessel**, and the **shield building** with steel reinforced concrete walls 2 feet thick. The shield building protects the containment vessel from a variety of environmental factors and provides an area for a **negative pressure boundary** around the steel containment vessel. In the event that the integrity of the containment vessel is compromised (e.g., a crack develops), this negative pressure boundary ensures that any airborne radioactive contamination present in the containment vessel is prevented from leaking out into the environment. This is accomplished by maintaining the pressure inside the shield building lower than that outdoors, thus forcing clean outside air to leak in, while making it impossible for the contaminated air between the containment vessel and the shield building to leak out. The free-standing containment vessel is the third in a **series of barriers** that prevent the release of fission products in the unlikely event of an accident. The first barrier to the release of fission products is the fuel cladding itself. The second barrier is the walls of the primary system, i.e. the reactor vessel, steam generator and associated piping.

The Steam Generators

The **steam generators** perform the same function as a boiler at a fossil-fueled power station. The steam generator uses the heat of the primary coolant inside the steam generator tubes to boil the secondary side **feedwater** (secondary coolant). Fission heat from the reactor core is transferred to the steam generator in order to provide the steam necessary to drive the turbine. However, heat must also be removed from the core even after reactor shutdown in order to prevent damage to the fuel cladding. Therefore, pumps maintain a continuous flow of coolant through the reactor and steam generator. **Primary loop water** (green in Figure 7) exits the reactor at approximately 606°F, passes through the steam generator, transferring some of its heat energy to the **secondary loop water** (blue in Figure 7) without actually coming in contact with it. Primary coolant water exits the steam generator at approximately 558°F to be circulated back into the reactor where it is again heated to 606°F as it passes up through the fuel assemblies. Under ordinary conditions, water inside the primary system would boil long before it reached such temperatures. However, it is kept under a pressure of approximately 2,200 pounds-per-square-inch (psi) at all times. This prevents the water from boiling and is the reason the reactor at Davis-Besse is called a Pressurized Water Reactor. Secondary loop water enters the base of the steam generator at approximately 450°F and under 1,100 psi pressure. At this pressure, the water can easily boil into steam as it passes over the tubes containing the primary coolant water.

Both the primary and the secondary coolant water are considered **closed loop systems**. This means they are designed not to come in physical contact with one another. Rather, the coolant water contained in each loop transfers heat energy by the process of **convection**. Convection is a method of **heat transfer** that can occur between two fluid media. It is the same process by which radiators are used to heat homes. The water circulating inside the radiator is separated from the air (a "fluid" medium) by the metal piping.

The Turbine - Generator

The turbine, main generator, and the condenser are all housed in what is commonly referred to as the **Turbine Building**. The purpose of the **turbine** is to convert the **thermal energy** of the steam produced in the steam generator (referred to as **main steam**, red in Figure 7) to **rotational energy** of the turbine generator shaft. The turbine at Davis-Besse is actually composed of one six-stage high pressure turbine and two seven-stage low pressure turbines aligned on a common shaft. A **turbine stage** refers to a set of blades. Steam enters at the center of each turbine and flows outward along the shaft in opposite directions through each successive stage of blading. As the steam passes over the turbine blades, it loses pressure. Thus, the blades must be proportionally larger in successive stages to extract enough energy from the steam to rotate the shaft at the correct speed.

The purpose of the **main generator** is to convert the rotational energy of the shaft to **electrical energy** for commercial usage and support of station systems. The main generator is composed of two parts, a stationary **stator** that contains coils of copper conductors, and a **rotor** that supplies a rotating magnetic field within the coils of the stator. Electrical current is generated in the stator portion of the main generator. From this point, the electric current passes through a series of **transformers** for transmission and use throughout northern Ohio.

The Condenser

After the spent steam in the secondary loop (blue in Figure 7) passes through the high and low pressure turbines, it is collected in a cavernous **condenser** several stories tall and containing more than 70,000 small tubes. **Circulating water** (yellow in Figure 7) goes to the **cooling tower** after passing through the tubes inside the condenser. As the steam from the low pressure turbines passes over these tubes, it is cooled and condensed. The condensed water is then purified and reheated before being circulated back into the steam generator again in a closed loop system. Circulating water forms the third (or **tertiary**) and final loop of cooling water used at the Davis-Besse Station.

Similar to the primary to secondary interface, the secondary to tertiary interface is based on a closed loop design. The circulating water is able to cool the steam in the condenser, without ever actually coming in contact with it, by the process of convection. Even in the event of a primary to secondary leak, the water vapor exiting the Davis-Besse cooling tower would remain non-radioactive. Closed loops are an integral part of the design of any nuclear facility. This design feature greatly reduces the chance of environmental impact from station operation.

The Cooling Tower

The cooling tower at Davis-Besse is easily the most noticeable feature of the plant. The tower stands 493 feet high and the diameter of the base is 411 feet. The two pipes circulating 480,000 gallons of water per minute to the tower are 9 feet in diameter. The purpose of the tower is to recycle water from the condenser by cooling it.

After passing through the condenser, the circulating water has warmed to approximately 100°F. In order to cool the water back down to around 70°F, the circulating water enters the cooling tower about 40 feet above the ground. The water is sprayed evenly over a series of baffles called **fillsheets** which are suspended vertically in the base of the tower. A natural draft of air blowing up through these baffles cools the water through the process of **evaporation**. The evaporated water exits the top of the cooling tower in the form of **water vapor**.

As much as 10,000 gallons of water per minute are lost to the atmosphere via the cooling tower. Even so, approximately 98 percent of the water drawn from Lake Erie for station operation can be recycled through the cooling tower for reuse. A small portion of the circulating water is discharged back to Lake Erie at essentially the same temperature it was withdrawn earlier. The slightly warmer discharge water had no adverse environmental impact on the area of lake surrounding the discharge point.

Miscellaneous Station Safety Systems

The orange system in Figure 7 is part of the **Emergency Core Cooling System (ECCS)** housed in the **Auxiliary Building** of the station. The ECCS consists of three overlapping means of keeping the reactor core covered with water, in the unlikely event of a Loss Of Coolant Accident (LOCA), thereby protecting the fuel cladding barrier against high temperature failure. Depending upon the severity of the loss of pressure inside the primary system, the ECCS will automatically channel borated water into the reactor by either **high pressure injection pumps,** a **core flood tank,** or **low pressure injection pumps**. Borated water can also be sprayed from the ceiling of the containment vessel to cool and condense any steam that may escape from the primary system.

The violet system illustrated in Figure 7 is responsible for maintaining the primary coolant water in a liquid state. It accomplishes this by adjusting the pressure inside the primary system. Heaters inside the **pressurizer** turn water into steam. This steam takes up more space inside the pressurizer, thus increasing the overall pressure inside the primary system. The pressurizer is equipped with spray heads that shower cool water over the steam in the unit. In this case, the steam condenses and the overall pressure inside the primary system drops. The **quench tank** pictured in Figure 8 is simply where excess steam is directed and condensed for storage.

The scarlet system in Figure 7 is part of the **Auxiliary Feedwater System**, a key safety system in event the main feedwater supply (blue in Figure 7) to the steam generator is lost. Following a reactor shutdown, the Auxiliary Feedwater System can supply water to the steam generators from the **Condensate Storage Tanks**. The Auxiliary Feedwater System is housed in the Turbine Building along with the turbine, main generator, and the condenser.

Reactor Safety and Summary

Nuclear power plants are inherently safe, not only by the laws of physics, but by design. Nuclear power plants cannot explode like a bomb because the concentration of fissionable material is far less than is necessary for such a nuclear explosion. Also, many safety features are equipped with several backup systems to ensure that any possible accident would be prevented from causing a serious health or safety threat to the public, or serious impact on the local environment. Davis-Besse, like all U.S. nuclear units, has many overlapping, or redundant safety features. If one system should fail, there are still back-up systems to assure the safe operation of the Station. During normal operation, the **Reactor Control System** regulates the power output by adjusting the position of the control rods. The reactor can be automatically shut down by a separate **Reactor Protection System** that causes all the control rod assemblies to be quickly and completely inserted into the reactor core, stopping the chain reaction. To guard against the possibility of a Loss Of Coolant Accident, the Emergency Core Cooling System is designed to pump reserve water into the reactor automatically if the reactor coolant pressure drops below a predetermined level.

The Davis-Besse Nuclear Power Station was designed, constructed, and operates to produce a reliable, safe, and environmentally sound source of electricity.

Radioactive Waste

Many of the activities we depend on in our everyday lives produce radioactive waste by-products. Nuclear energy, industrial processes, and medical treatments are some of these activities. These by-products are managed and disposed of under strict requirements set by the federal government. With the exception of used nuclear fuel assemblies, these by-products produced at commercial power plants are referred to as low level radioactive waste.

Low Level Radioactive Waste

Low level radioactive waste consists mainly of ordinary trash and other items that have become contaminated with radioactive materials. It includes plastic gloves and other protective clothing, machine parts and tools, medical and laboratory equipment, filters, resins, and general scrap.

The radioactive material in low level radioactive waste emits the same types of radiation that naturally occurring radioactive materials tend to emit. Most low level radioactive waste "decays" to background levels of radioactivity in months or years. Nearly all of it diminishes to stable materials in less than 300 years.

Davis-Besse presently ships low level radioactive waste to a South Carolina disposal facility located at Barnwell, South Carolina. This facility was closed to out of compact generators from July 1, 1994 to July 1, 1996. The facility was reopened by South Carolina to all generators on July 1, 1996. At this time, Davis-Besse resumed shipping of low level radioactive waste to the facility. Davis-Besse has the capacity to store low level waste it produced on site, in the Low Level Radioactive Waste Storage Facility (LLRWSF) for several years in the event the Barnwell facility closes again.

High Level Nuclear Waste

Like any industrial or scientific process, nuclear energy does produce waste. The most radioactive is defined as "high-level" waste (because it has high levels of radioactivity). Ninety-nine percent of high-level waste from nuclear plants is used nuclear fuel. The fuel undergoes certain changes during fission. Most of the fragments of fission, pieces that are left over after the atom is split, are radioactive. After a period of time, the fission fragments trapped in the fuel assemblies reduce the efficiency of the chain reaction. Every 18 to 24 months, the oldest fuel assemblies are removed from the reactor and replaced with fresh fuel.

High-level nuclear waste volumes are small. Davis-Besse produces about 30 tons of used fuel every 24 months. All the used fuel produced by all America's nuclear energy plants since the first plant started operating over 30 years ago would cover an area the size of a football field about five yards deep. All of America's nuclear plants combined produce only 3,000 tons of used fuel each year. By contrast, the U.S. produces about 300 million tons of chemical waste annually. Also, nuclear waste slowly loses its radioactivity, but some chemical waste remains hazardous indefinitely.

Davis-Besse presently stores its used fuel in a steel-lined concrete vault, filled with water, inside the plant. The Department of Energy is charged with constructing a permanent high-level waste repository for all of the nation's nuclear plants. By law, the Department of Energy must accept fuel from utilities by the end of 1998. Currently, Yucca Mountain, Nevada, is being considered as a possible site. Until the permanent DOE site is developed, nuclear plants will be responsible for the continued safe storage of high-level waste. At Davis-Besse, the fuel pool reached its capacity in 1996. At the end of 1996, Davis-Besse began the process of moving the older fuel assemblies that no longer require water cooling to air cooled concrete shielded canisters. These will remain stored onsite until the Department of Energy facilities are ready to receive them. Dry fuel storage is already used in many countries, including Canada, and in the U.S. at nuclear plants in Arkansas, Colorado, Maryland, Michigan, Minnesota, Virginia, Wisconsin and South Carolina. Figure 8 illustrates the dry fuel storage module arrangement at Davis-Besse.

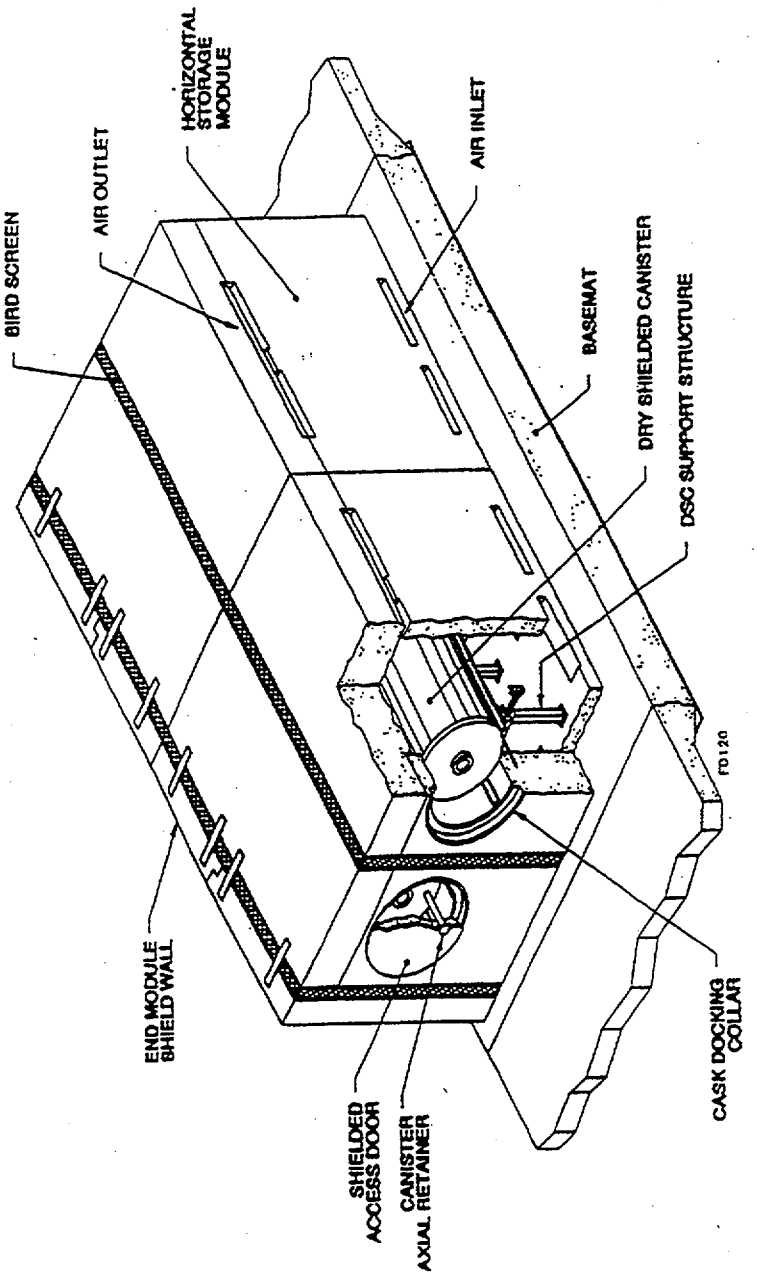

Figure 8: Dry Fuel Storage Module Arrangement

Description of the Davis-Besse Site

The Davis-Besse site is located in Carroll Township of Ottawa County, Ohio. It is on the south-western shore of Lake Erie, just north of the Toussaint River. The site lies north and east of Ohio State Route 2, approximately 10 miles northwest of Port Clinton, 7 miles north of Oak Harbor, and 25 miles east of Toledo, Ohio (Figure 9).

This section of Ohio is flat and marshy, with maximum elevations of only a few feet above the level of Lake Erie. The area originally consisted of swamp forest and marshland, rich in wildlife but unsuitable for settlement and farming. During the nineteenth century, the land was cleared and drained, and has been farmed successfully since. Today, the terrain consists of farmland with marshes extending in some places for up to two miles inland from the Sandusky Lake Shore Ridge.

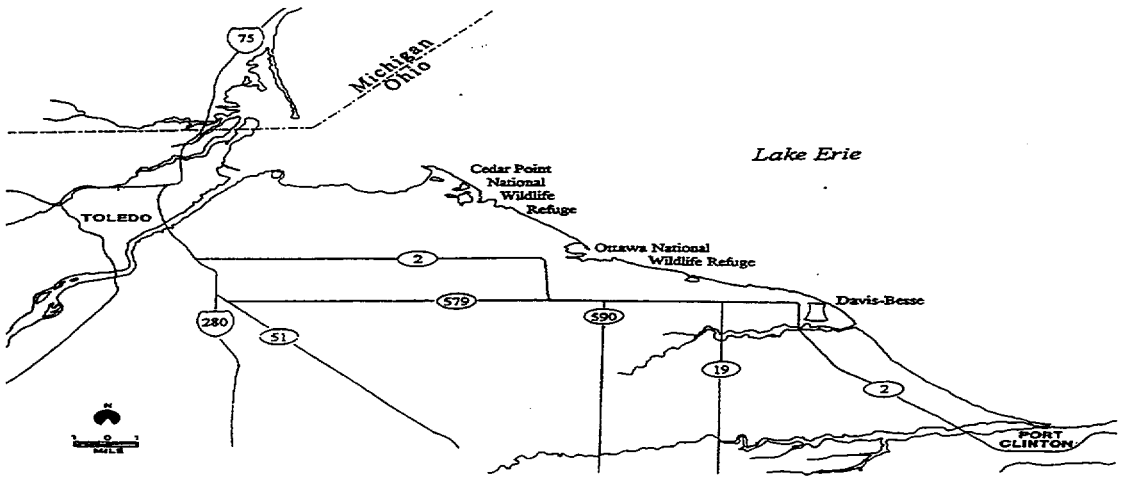

Figure 9: Davis-Besse is near Oak Harbor, Port Clinton, and the Ottawa National Wildlife Refuge.

Davis-Besse site is mainly comprised of marshland with a small portion consisting of farmland. The marshes are part of a valuable ecological resource, providing a breeding ground for a variety of wildlife, and a refuge for migratory birds. The site includes a tract known as Navarre Marsh, which was acquired from the U.S. Bureau of Sport Fisheries and Wildlife, Department of the Interior. In 1971, Toledo Edison purchased the 188-acre Toussaint River Marsh. The Toussaint River Marsh is contiguous with the 610-acre Navarre Marsh section of the Ottawa National Wildlife Refuge.

The immediate area near Davis-Besse is sparsely populated; Ottawa County had a population of 40,029 in the 1990 census. The nearest incorporated communities are:

- Port Clinton - 10 miles southeast, population 7,106
- Oak Harbor - 7 miles south, population 2,637
- Rocky Ridge - 7 miles west southwest, population 425
- Toledo (the nearest major city) - 25 miles west, population 322,943

There are some residences along the lake shore used mainly as summer homes. However, the major resort area of the county is farther east, around Port Clinton, Lakeside, and the Bass Islands.

The non-marsh areas around the Davis-Besse site are utilized primarily for farming. The major crops include soybeans, corn, wheat, oats, hay, fruits and vegetables. Meat and dairy animals are not major sources of income in the area. The main industries within five miles of the site are located in Erie Industrial Park, about four miles southeast of the station.

Most of the remaining marshes in the area have been maintained by private hunting clubs, the U.S. Fish and Wildlife Service, and the Ohio Department of Natural Resources, Division of Wildlife. The State of Ohio Department of Natural Resources operates many wildlife and recreational areas within 10 miles of the Station. These include Magee Marsh, Turtle Creek, Crane Creek State Park, and the Ottawa National Wildlife Refuge. Magee Marsh and Turtle Creek lie between three and six miles WNW of the Station. Magee Marsh is a wildlife preserve allowing public fishing, nature study, and controlled hunting season. Turtle Creek, a wooded area at the southern end of Magee Marsh, offers boating and fishing. Crane Creek State Park is adjacent to Magee Marsh and is a popular picnicking , swimming, and fishing area. The Ottawa National Wildlife Refuge lies four to nine miles WNW of the Site, immediately west of Magee Marsh.

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Radiological Environmental Monitoring Program

Radiological Environmental Monitoring Program

Introduction

The **Radiological Environmental Monitoring Program (REMP)** was established at Davis-Besse for several reasons: to provide a supplementary check on the adequacy of containment and effluent controls, to assess the radiological impact of the Station's operation on the surrounding area, and to determine compliance with applicable radiation protection guides and standards. The REMP was established in 1972, five years before the Station became operational. This **preoperational surveillance program** was established to describe and quantify the radioactivity, and its variability, in the area prior to the operation of Davis-Besse. After Davis-Besse became operational in 1977, the **operational surveillance program** continued to measure radiation and radioactivity in the surrounding areas.

A variety of environmental samples are collected as part of the REMP at Davis-Besse. The selection of sample types is based on the established critical pathways for the transfer of radionuclides through the environment to humans. The selection of sampling locations is based on sample availability, local meteorological and hydrological characteristics, local population characteristics, and land usage in the area of interest. The selection of sampling frequencies for the various environmental media is based on the radionuclides of interest, their respective half-lives, and their behavior in both the biological and physical environment.

A description of the REMP at Davis-Besse is provided in the following section. In addition, a brief history of analytical results for each sample type collected since 1972, and a more detailed summary of the analyses performed during this reporting period, is also provided.

Preoperational Surveillance Program

The federal government requires nuclear facilities to conduct radiological environmental monitoring prior to constructing the facility. This preoperational surveillance program is aimed at collecting the data needed to identify critical pathways, including selection of the radioisotope and sample media combinations to be included in the surveillance program conducted after facility operation begins. Radiochemical analyses performed on the environmental samples should include not only those nuclides expected to be released during facility operation, but should also include typical fallout radionuclides and natural background radioactivity. All environmental media with a potential to be affected by facility operation, as well as those media directly in the critical pathways, should be sampled on at least an annual basis during the preoperational phase of the environmental surveillance program.

The preoperational surveillance design, including nuclide/media combinations, sampling frequencies and locations, collection techniques, and radioanalyses performed, should be carefully considered and incorporated in the design of the operational surveillance program. In this manner, data can be compared in a variety of ways (for example: from year to year, location to location, etc.) in order to detect any radiological impact the facility has on the surrounding environment. Data collection during the preoperational phase should be planned to provide a comprehensive database for evaluating any future changes in the environment surrounding the nuclear facility.

Davis-Besse began its preoperational environmental surveillance program five years before the Station began producing power for commercial use in 1977. Data accumulated during those early years provide an extensive database from which Station personnel are able to identify trends in the radiological characteristics of the local environment. The environmental surveillance program at Davis-Besse will continue after the Station has reached the end of its economically useful life and decommissioning has begun.

Operational Surveillance Program Objectives

The operational phase of the environmental surveillance program at Davis-Besse was designed with the following objectives in mind:

- to fulfill the obligations of the radiological surveillance sections of the Station's Technical Specifications and Offsite Dose Calculation Manual;
- to determine whether any significant increase occurs in the concentration of radionuclides in critical pathways;
- to identify and evaluate the buildup, if any, of radionuclides in the local environment, or any changes in normal background radiation levels; and
- to verify the adequacy of Station controls for the release of radioactive materials.

Quality Assurance

An important part of the environmental monitoring program at Davis-Besse is the **Quality Assurance (QA) Program**. It is conducted in accordance with the guidelines specified in NRC Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs." The QA program is designed to identify possible deficiencies in the REMP so that corrective actions can be initiated promptly. Davis-Besse's Quality Assurance program also provides confidence in the results of the REMP through:

- performing regular audits (investigations) of the REMP, including a careful examination of sample collection techniques and record keeping;
- performing audits of contractor laboratories which analyze the environmental samples;
- requiring analytical contractor laboratories to participate in the United States Environmental Protection Agency Cross-Check Program;

- requiring analytical contractor laboratories to split samples for separate analysis followed by a comparison of results;
- splitting samples prior to analysis by independent laboratories, and then comparing the results for agreement, and, finally;
- requiring analytical contractor laboratories to perform in-house spiked sample analyses.

Quality Assessment audits and inspections of the Davis-Besse REMP are performed by Davis-Besse's QA department and the NRC. In addition, the NRC and the Ohio Department of Health (ODH) also perform independent environmental monitoring in the vicinity of Davis-Besse. The types of samples collected and the sampling locations used by the NRC and ODH were incorporated in Davis-Besse's REMP. Hence, the analytical results from the different programs can be compared. This practice of comparing results from identical samples, collected and analyzed by different parties, provides a valuable tool to verify the quality of the laboratories analytical procedures and the data generated.

In 1987, environmental sampling personnel at Davis-Besse incorporated their own QA program into the REMP. Duplicate samples, called quality control samples, were collected at several locations. These duplicate samples were assigned different identification numbers than the numbers assigned to the routine samples. This ensured that the analytical laboratory would not know the samples were identical. The laboratory results from analysis of the quality control samples and the routine samples could then be compared for agreement. Quality control sampling has been integrated into the program and has become an important part of the REMP since 1987. Quality control sampling locations are changed frequently in order to duplicate as many sampling locations as possible, and to ensure the contractor laboratory has no way of correctly pairing a quality control sample with its routine sample counterpart.

Program Description

Overview

The Radiological Environmental Monitoring Program (REMP) at Davis-Besse is conducted in accordance with Title 10, Code of Federal Regulations, Part 50; Regulatory Guide 4.8; the Davis-Besse Nuclear Power Station Operating License, Appendix A (Technical Specifications); the Davis-Besse Offsite Dose Calculation Manual (ODCM) and Station Operating Procedures. Samples are collected weekly, monthly, quarterly, semiannually, or annually, depending upon the sample type and nature of the radionuclides of interest. Environmental samples collected by Davis-Besse personnel are divided into four general types:

- **atmospheric** -- including samples of airborne particulates and airborne radio-iodine
- **terrestrial** -- including samples of milk, groundwater, broad leaf vegetation, fruits, animal/wildlife feed, soil, and wild and domestic meat
- **aquatic** -- including samples of treated and untreated surface water, fish, and shoreline sediments
- **direct radiation** -- measured by thermoluminescent dosimeters

All environmental samples are labeled using a sampling code. Table 2 provides the sample codes and collection frequency for each sample type.

REMP samples are collected onsite and offsite up to 25 miles away from the Station. Sampling locations may be divided into two general categories: indicator and control. Indicator locations are those which would be most likely to display the effects caused by the operation of Davis-Besse. Generally, they are located within five miles of the station. Control locations are those which should be unaffected by Station operations. Typically, these are more than five miles away from the Station. Data obtained from the indicator locations are compared with data from the control locations. This comparison allows REMP personnel to take into account naturally occurring background radiation or fallout from weapons testing in evaluating any radiological impact Davis-Besse has on the surrounding environment. Data from indicator and control locations are also compared with preoperational data to determine whether significant variations or trends exist.

Since 1987, the REMP has been reviewed and modified to develop a comprehensive sampling program adjusted to the current needs of the utility. Modifications have included additions of sampling locations above the minimum amount required in the ODCM and increasing the number of analyses performed on each sample. Besides adding new locations, duplicate or Quality Control (QC) sample collection was initiated to verify the accuracy of the lab analyzing the environmental samples. These additional samples are referred to as the REMP Enhancement Samples. Approximately 2200 samples were collected and over 2300 analyses were performed during 1999. In addition, 15% of the sampling locations were quality control sampling locations. Table 3 shows the number of the sampling location and number collected for each type.

Table 2: Sample Codes and Collection Frequencies

Sample Type	Sample Code	Collection Frequency
Airborne Particulate	AP	Weekly
Airborne Iodine	AI	Weekly
Thermoluminescent Dosimeter	TLD	Quarterly, Annually
Milk	MIL	Monthly (semi-monthly during grazing season)
Groundwater	WW	Quarterly
Broadleaf Vegetation	BLV	Monthly (when available)
Surface Water - Treated	SWT	Weekly
Surface Water - Untreated	SWU	Weekly (lake water , monthly)
Fish	FIS	Annually
Shoreline Sediment	SED	Semiannually
Soil	SOI	Semiannually
Animal/Wildlife Feed	DFE/WFE	Annually
Meat-Domestic	DME	Annually
Meat-Wild	WME	Annually
Fruit	FRU	Annually

Table 3: Sample Collection Summary

Sample Type (Remarks)	Collection Type*/ Frequency**	Number of Locations	Number of Samples Collected	Number of Samples Missed
Atmospheric				
Airborne Particulates	C/W	10	520	0
Airborne Radioiodine	C/W	10	520	0
Terrestrial				
Milk (Jan.-Dec.)	G/M	1	12	0
Groundwater	G/Q***	2	5	0
Edible Meat				
Wild	G/A	1	1	0
Domestic	G/A	2	2	0
Broadleaf				
Vegetation / Fruit	G/M	6	13	0
Soil	G/S	10	20	0
Animal/Wildlife Feed	G/A	5	5	0
Aquatic				
Treated	Comp/WM	2	104	0
Surface Water	G/WM***	3	156	0
Untreated	G/WM***	2	103	1****
Surface Water	G/M	10	70	0
	Comp/WM	3	156	0
Fish (3 species)	G/SA	2	6	0
Shoreline Sediments	G/SA	5	10	0
Direct Radiation				
Thermoluminescent	C/Q***	75	295	5
Dosimeters (TLD)	C/A***	75	74	1

* Type of Collection: C = Continuous; G = Grab; Comp = Composite
** Frequency of Collection: WM = Weekly composite Monthly; W = Weekly
*** Includes quality control location, SWU and SWT QC included in weekly grab sample/composited monthly
****Hazardous weather conditions prevented sample collection
SM = Semimonthly; M = Monthly; Q = Quarterly; SA = Semiannually; A = Annually

Sample Analysis

When environmental samples are analyzed, several types of measurements may be performed to provide information about the radionuclides present. The major analyses that are performed on environmental samples collected for the Davis-Besse REMP include:

Gross beta analysis measures the total amount of beta emitting radioactive material present in a sample. Beta radiation may be released by many different radionuclides. Since beta decay gives a continuous energy spectrum rather than the discrete lines or "peaks" associated with gamma radiation, identification of specific beta emitting nuclides is much more difficult. Therefore, gross beta analysis only indicates whether the sample contains normal or abnormal concentrations of beta emitting radionuclides; it does not identify specific radionuclides. Gross beta analysis merely acts as a tool to identify samples that may require further analysis.

Gamma spectral analysis provides more specific information than does gross beta analysis. Gamma spectral analysis identifies each gamma emitting radionuclide present in the sample, and the amount of each nuclide present. Each radionuclide has a very specific "fingerprint" that allows for swift and accurate identification. For example, gamma spectral analysis can be used to identify the presence and amount of iodine-131 in a sample. Iodine-131 is a man-made radioactive isotope of iodine that may be present in the environment as a result of fallout from nuclear weapons testing, routine medical uses in diagnostic tests, and routine releases from nuclear power stations.

Tritium analysis indicates whether a sample contains the radionuclide tritium (H-3) and the amount present. As discussed in the Introduction Section, tritium is an isotope of hydrogen that emits low energy beta particles.

Strontium analysis identifies the presence and amount of strontium-89 and strontium-90 in a sample. These man-made radionuclides are found in the environment as a result of fallout from nuclear weapons testing. Strontium is usually incorporated into the calcium pool of the biosphere. In other words, strontium tends to replace calcium in living organisms and becomes incorporated in bone tissue. The principal strontium exposure pathway is via milk produced by cattle grazed on pastures exposed to deposition from airborne releases.

Gamma Doses measured by thermoluminescent dosimeters while in the field are determined by a special laboratory procedure. Table 4 provides a list of the analyses performed on environmental samples collected for the Davis-Besse REMP.

Often samples will contain little radioactivity, and may be below the lower limit of detection for the particular type of analysis used. The lower limit of detection (LLD) is the smallest amount of sample activity which can be detected with a reasonable degree of confidence, at a predetermined level. When a measurement of radioactivity is reported as less than LLD (<LLD), it means that the radioactivity is so low that it cannot be accurately measured with any degree of confidence by that particular method for an individual analysis.

Table 4: Radiochemical Analyses Performed on REMP Samples

Sample Type	Analyses Performed
Atmospheric Monitoring	
Airborne Particulate	Gross Beta Gamma Spectral Strontium-89 Strontium-90
Airborne Radioiodine	Iodine-131
Terrestrial Monitoring	
Milk	Gamma Spectral Iodine-131 Strontium-89 Strontium-90 Stable Calcium Stable Potassium
Groundwater	Gross Beta Gamma Spectral Tritium Strontium-89 Strontium-90
Broadleaf Vegetation and Fruits	Gamma Spectral Iodine-131 Strontium-89 Strontium-90
Animal/Wildlife Feed	Gamma Spectral
Soil	Gamma Spectral
Wild and Domestic Meat	Gamma Spectral

Table 4: Radiochemical Analyses Performed on REMP Samples (continued)

Sample Type	Analyses Performed
Aquatic monitoring	
Untreated Surface Water	Gross Beta Gamma Spectral Tritium Strontium-89 Strontium-90
Treated Surface Water	Gross Beta Gamma Spectral Tritium Strontium-89 Strontium-90 Iodine-131
Fish	Gross Beta Gamma Spectral
Shoreline Sediment	Gamma Spectral
Direct Radiation Monitoring	
Thermoluminescent Dosimeters	Gamma Dose

Sample History Comparison

The measurement of radioactive materials present in the environment will depend on factors such as weather or variations in sample collection techniques or sample analysis. This is one reason why the results of sample analyses are compared with results from other locations and from earlier years. Generally, the results of sample analyses are compared with preoperational and operational data. Additionally, the results of indicator and control locations are also compared. This allows REMP personnel to track and trend the radionuclides present in the environment, to assess whether a buildup of radionuclides is occurring and to determine the effects, if any, the operation of Davis-Besse is having on the environment. If any unusual activity is detected, it is investigated to determine whether it is attributable to the operation of Davis-Besse, or to some other source such as nuclear weapons testing. A summary of the REMP sample analyses performed from 1972 through the current reporting period is provided in the following section.

Atmospheric Monitoring

- **Airborne Particulates:** No radioactive particulates have been detected as a result of Davis-Besse's operation. Only natural and fallout radioactivity from nuclear weapons testing and the 1986 nuclear accident at Chernobyl have been detected.
- **Airborne Radioiodine:** Radioactive iodine-131 fallout was detected in 1976, 1977, and 1978 from nuclear weapons testing, and in 1986 (0.12 to 1.2 picocuries per cubic meter) from the nuclear accident at Chernobyl.

Terrestrial Monitoring:

- **Groundwater:** Only naturally occurring radioactive material has been detected in groundwater.
- **Milk:** Iodine-131 from nuclear weapons testing fallout was detected in 1976 and 1977 at concentrations of 1.36 and 23.9 picocuries/liter respectively. In 1986, concentrations of 8.5 picocuries/liter were detected from the nuclear accident at Chernobyl. No iodine-131 detected has been attributable to the operation of Davis-Besse.
- **Domestic and Wild Meat:** Only naturally occurring potassium-40 and very low cesium-137 from fallout activity has been detected in meat samples. Potassium-40 has ranged from 1.1 to 4.6 picocuries/gram wet weight. Cesium-137 was detected in 1974, 1975, and 1981 due to fallout from nuclear weapons testing.
- **Broadleaf Vegetation and Fruits:** Only naturally occurring radioactive material and material from nuclear weapons testing has been detected.
- **Soil:** Only natural background and material from nuclear weapons testing and the 1986 nuclear accident at Chernobyl has been detected.
- **Animal/Wildlife Feed:** Only natural background and material from weapons testing has been detected.

Aquatic Monitoring

- **Surface Water (Treated and Untreated):** In 1979 and 1980, the tritium concentrations at location T-7 were above normal background. Location T-7 is a beach well fed directly by Lake Erie. The fourth quarter sample in 1979 read 590 picocuries per liter, and the first quarter sample in 1980 had a concentration of 960 picocuries per liter. A follow-up sample was collected in Lake Erie between T-7 and the Davis-Besse liquid discharge point. This sample contained tritium at a concentration of 2737 picocuries per liter. These concentrations could be attributed to the operation of Davis-Besse. Even so, these results at T-7 were more than 39 times lower than the annual average concentration allowed by the EPA National Interim Primary Drinking Water Regulations (40CFR141), and were only 0.032% of the Maximum Permissible Concentration (MPC of 3,000,000 picocuries per liter) for tritium in unrestricted areas. The follow-up sample was less than 0.1% of the MPC. None of the subsequent samples indicate any significant difference between the background tritium concentration and the concentration at T-7.

  In 1991, the tritium concentration in the untreated surface water at T-130 was above normal background levels. T-130 is located in Lake Erie approximately 300 yards from the mouth of the Toussaint River. The August composite was 884 picocuries per liter. Follow up samples were less than the LLD of 330 picocuries per liter. Although this concentration may be attributed to the operation of Davis-Besse, it was only 0.029% of the maximum permissible concentration for tritium in an unrestricted area. This did not have any significant adverse effect on the environment and the population near the station.

  The December 1992 composite for tritium at T-3 (mouth of Toussaint River) showed trace amounts of activity, which may be attributed to the normal operation of the station. The tritium concentration for the composite was 950 pCi/l. This is only 0.032 percent of the maximum permissible concentration of 3,000,000 pCi/l for tritium in an unrestricted area, as stated in 10 CFR 20, Appendix B, Table 2. Subsequent samples collected during January 1993 showed that the tritium had returned to below the LLD of 330 pCi/l.

  In the fourth quarter of 1994, tritium was detected at 336$\pm$94 pCi/l, slightly above the lower limit of detection for tritium, at one of the treated water sampling locations. Tritium was also detected at several of the untreated water sampling locations at an average concentration of 470 pCi/l during the 3rd and 4th quarters of 1994. Samples taken in January 1995 indicated that the tritium concentration in untreated water was less than the lower limit of detection for tritium in water. For comparison purposes, tritium concentrations in Lake Erie untreated surface water, determined during the preoperational sampling period of July 1972 through June 1974, ranged from 180 pCi/l to 590 pCi/l with an average concentration of less than 300 pCi/l.

In 1995, trace amounts of tritium were detected in six untreated water samples collected in May and one sample collected in October. The tritium detected ranged between 330 to 1234 pCi/l with an average concentration of 681 pCi/l. This is well below the allowable effluent concentration limit of 20,000 pCi/l for tritium in an unrestricted area, as stated in 40 CFR 141. Subsequent samples taken showed the tritium activity to be <330 pCi/l.

During 1996, tritium was detected ranged between 330 and 589 pCi/l with an average concentration of 340.3 pCi/l in 8 untreated surface water samples. Tritium in the remaining untreated surface water samples was <330 pCi/l.

During 1997, the tritium detected in 4 untreated surface water samples ranged between 340 and 575 pCi/l, and had an average concentration of 430 pCi/l. Even though these may be attributed to the operation of Davis-Besse, this average concentration is much less than the maximum permissible concentration allowed for tritium in unrestricted areas.

During 1999, tritium was detected in 11 untreated surface water samples. Ten samples ranged between 337 and 550 pCi/l. The eleventh, a control sample located 5.8 miles WNW of the station, measured 5288 pCi/l. The tritium in this sample is not thought to be from the operation of Davis-Besse for the following reasons: a) this control sample point is upstream of Davis-Besse, b) two indicator samples collected between this location and the plant showed no detectable tritium activity and, c) tritium was not detected in a subsequent sample taken at this location.

- **Fish:** Only natural background radioactive material and material from nuclear testing has been detected.
- **Shoreline Sediments:** Only natural background, material from nuclear testing and from the 1986 nuclear accident at Chernobyl has been detected.

Direct Radiation Monitoring:

- **Thermoluminescent Dosimeters (TLDs):** The annual average gamma dose rates for the current reporting period recorded by TLDs have ranged from 48.6 to 72.3 millirem per year at control locations and between 34.2 and 76.4 millirem per year at indicator locations. No increase above natural background radiation attributable to the operation of Davis-Besse has been observed.

1999 Program Deviations

Provided below is a description and explanation of 1999 environmental sample collection deviations:

- Broadleaf vegetation was not collected during January, February, March, April, May, June, November and December because of seasonal unavailability.

- Well Water sample at T-7 was not collected due to unavailability. The resident now uses the Carroll Township water system and the well is no longer in use.
- Annual and Quarterly TLDs at T-4 were missing on 1/22/99 and believed vandalized. New TLDs were installed.
- Annual and quarterly TLDs at sites T-4 and T-112 were missing on 4/6/99 and 4/8/99, respectively. New TLDs were installed at both locations. The T-4 TLD cage was moved about a short distance away to make it less obvious to vandals.
- Quarterly TLD at site T-91 found on ground with media missing. New quarterly TLD installed.
- Annual and Quarterly TLDs missing at locations T-11 and T-52 on 7/16/99. New TLDs ordered and installed at these locations.
- On 9/14/99, a composite untreated surface water sample was not available at T-11 because the collection tubing was clogged with sand and mud. A grab sample was collected and new tubing was installed on the sample compositor.
- On 11/17/99, a composite sample of treated surface water was not available at T-11 due to a change in scheduling of the new Ottawa County Water Plant personnel. County personnel had been manually compositing this sample while performing their daily analyses. Since the water is no longer analyzed on a daily basis, an automatic water compositor was installed at this location to ensure a daily composite is taken. A grab sample was taken.

Atmospheric Monitoring

Air Samples

Environmental air sampling is conducted to detect any increase in the concentration of airborne radionuclides that may be inhaled by humans or serve as an external radiation source. Inhaled radionuclides may be absorbed from the lungs, gastrointestinal tract, or from the skin. Air samples collected by the Davis-Besse REMP include both **airborne particulates** and **airborne radioiodine**.

Samples are collected weekly with low volume vacuum pumps which draw a continuous sample through a glass fiber filter and charcoal cartridge at a rate of approximately one cubic foot per minute. Airborne particulate samples are collected on 47 mm diameter filters. Charcoal cartridges are installed downstream of the particulate filters to sample for the airborne radioiodine.

The airborne samples are sent to an offsite contractor laboratory for analysis. At the laboratory, the airborne particulate filters are stored for 72 hours before they are analyzed to allow for the decay of naturally occurring short-lived radionuclides. However, due to the short half-life of iodine-131 (approximately eight days), the airborne radioiodine cartridges are analyzed upon receipt by the contractor laboratory.

Airborne Particulates

Davis-Besse continuously samples air for airborne radionuclides at ten locations. There are six indicator locations including four around the site boundary (T-1, T-2, T-3, and T-4), one at Sand Beach (T-7), and another at a local farm (T-8). There are four control locations, Oak Harbor (T-9), Port Clinton (T-11), Toledo (T-12) and Crane Creek (T-27).

Gross beta analysis is performed on each of the weekly samples. Each quarter, the filters from each location are combined (composite) and analyzed for gamma emitting radionuclides, strontium-89 and strontium-90.

Beta emitting radionuclides were detected at both the indicator and control locations at average concentration of 0.021 pCi/m^3 and 0.022 pCi/m^3, respectively. Beryllium-7 was the only gamma emitting radionuclide detected by the gamma spectroscopic analysis of the quarterly composites.

Beryllium-7 is a naturally occurring radionuclide produced in the upper atmosphere by cosmic radiation. No other gamma emitting radionuclides were detected above their respective LLDs. Strontium-89 (Sr-89) and Strontium-90 (SR-90) were not detected above their LLDs. These results show no adverse change in radioactivity in air samples due to operation of the Davis-Besse Nuclear Power Station in 1999.

Airborne Iodine-131

Airborne iodine-131 samples are collected at the same ten locations as the airborne particulate samples. Charcoal cartridges are placed downstream of the particulate filters. These cartridges

are collected weekly, sealed in separate collection bags and sent to the laboratory for gamma spectral analysis. In all of the samples collected in 1999, there was no detectable iodine-131 above the LLD of 0.07 pCi/m^3.

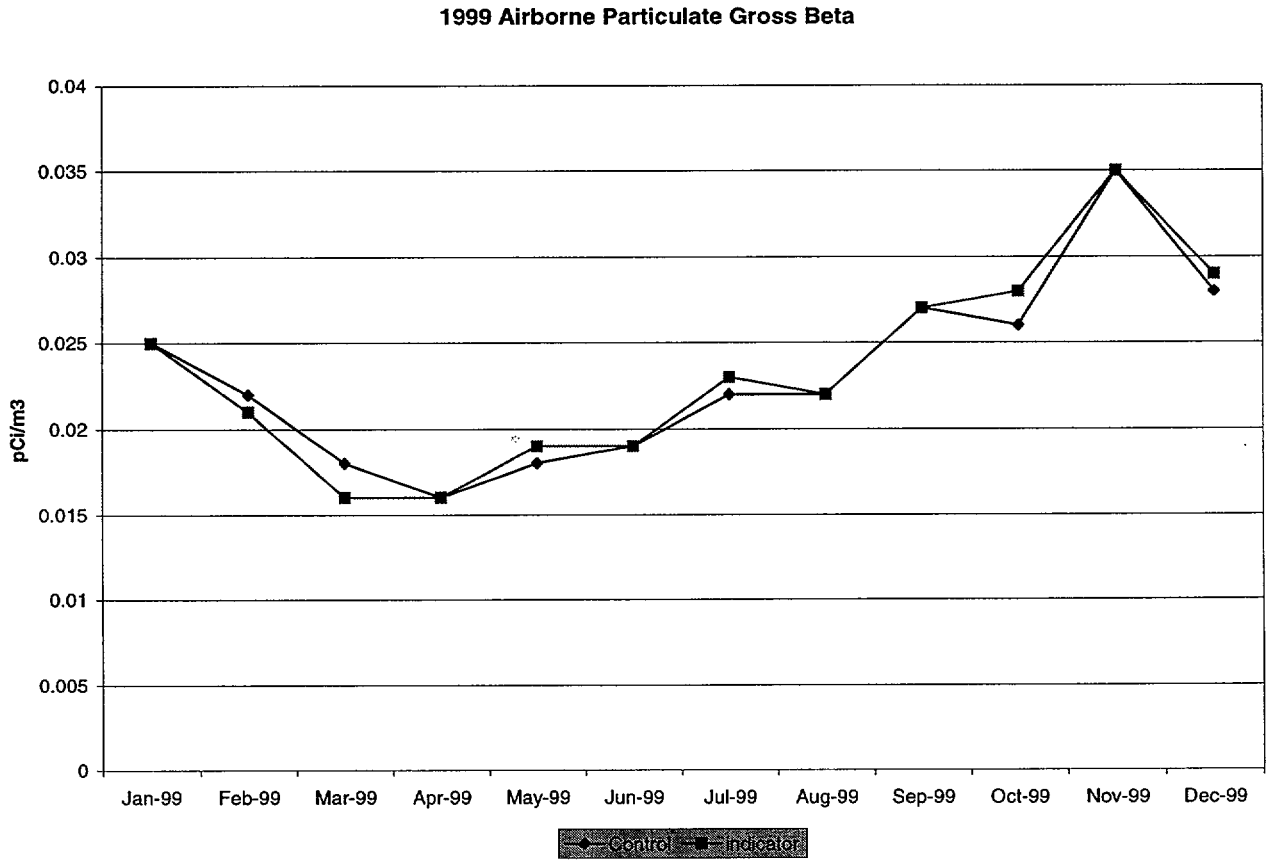

Figure 10: Concentration of beta-emitting radionuclides in airborne particulate samples were essentially identical at indicator and control locations.

Table 5: Air Monitoring Locations

Sample Location Number	Type of Location	Location Description
T-1	I	Site boundary, 0.6 miles ENE of Station
T-2	I	Site boundary, 0.9 miles E of Station
T-3	I	Site boundary, 1.4 miles ESE of Station
T-4	I	Site boundary, 0.8 miles S of Station
T-7	I	Sand Beach, main entrance, 0.9 miles NW of Station
T-8	I	Earl Moore Farm, 2.7 miles WSW of Station
T-9	C	Oak Harbor Substation, 6.8 miles SW of Station
T-11	C	Port Clinton Water Treatment Plant, 9.5 miles SE of Station
T-12	C	Toledo Water Treatment Plant, 23.5 miles WNW of Station
T-27	C	Crane Creek State Park, 5.3 miles WNW of Station

I = Indicator C = Control

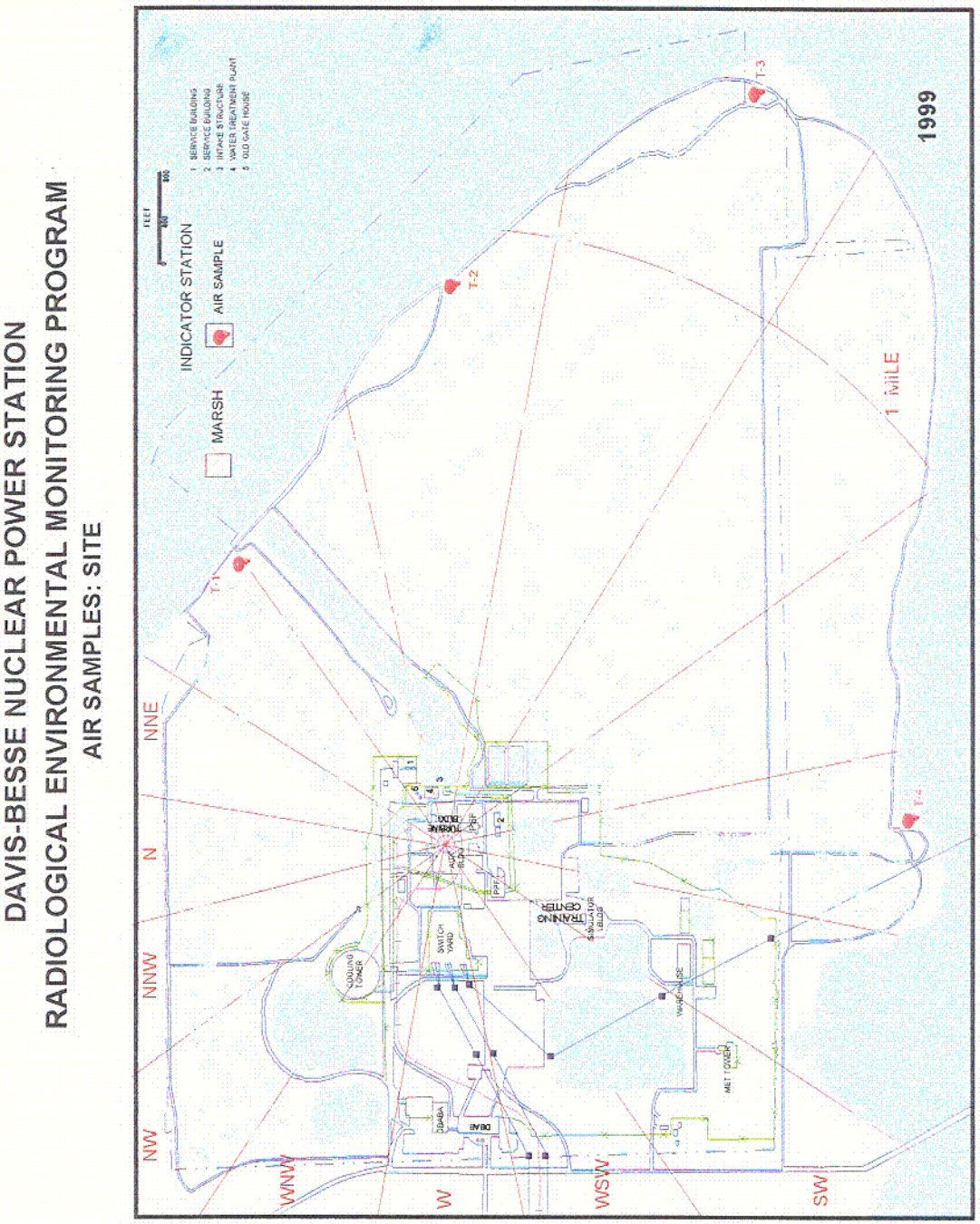

Figure 11: Air Sample Site Map

C2

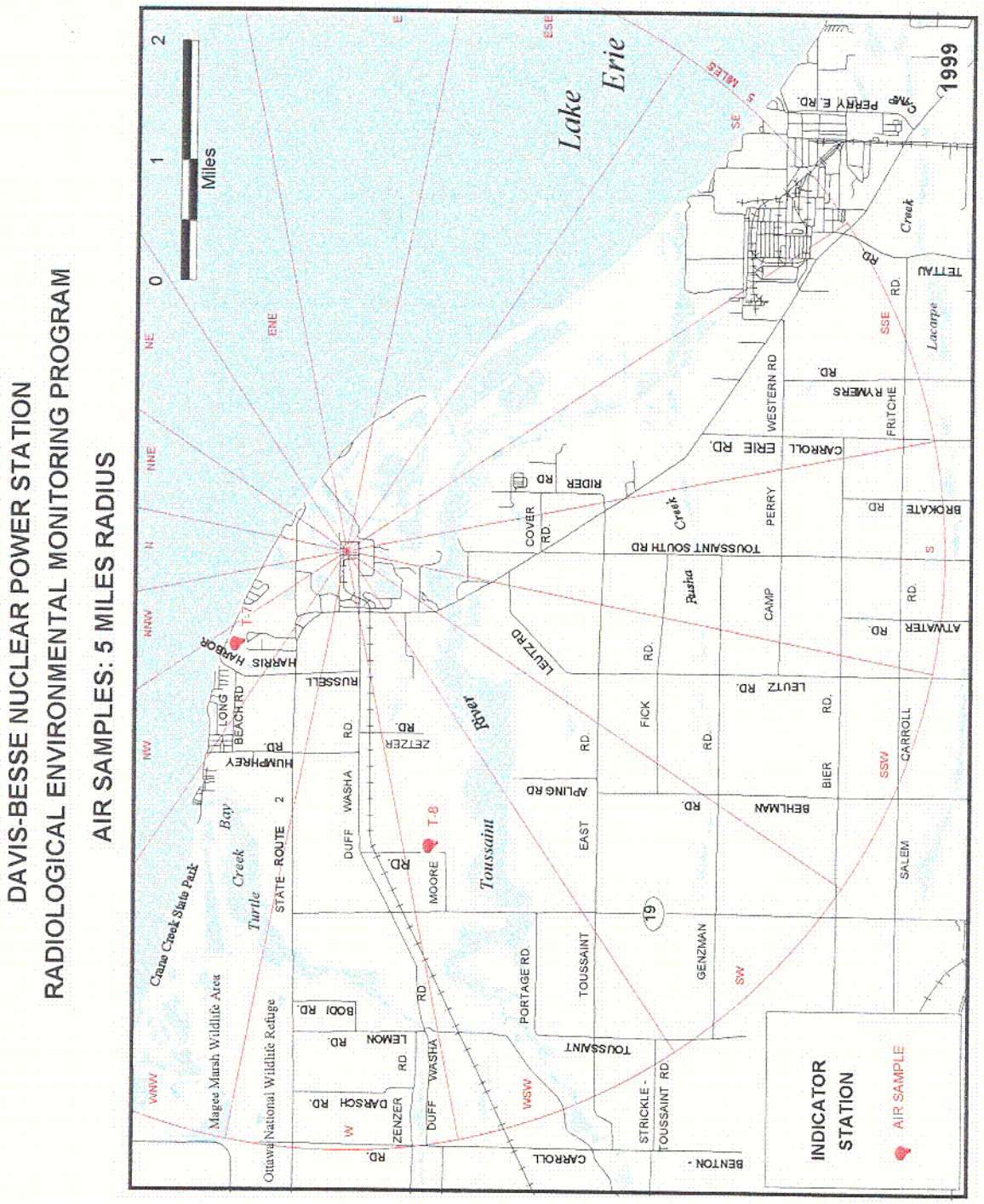

Figure 12: Air Sample 5-mile Map

C-3

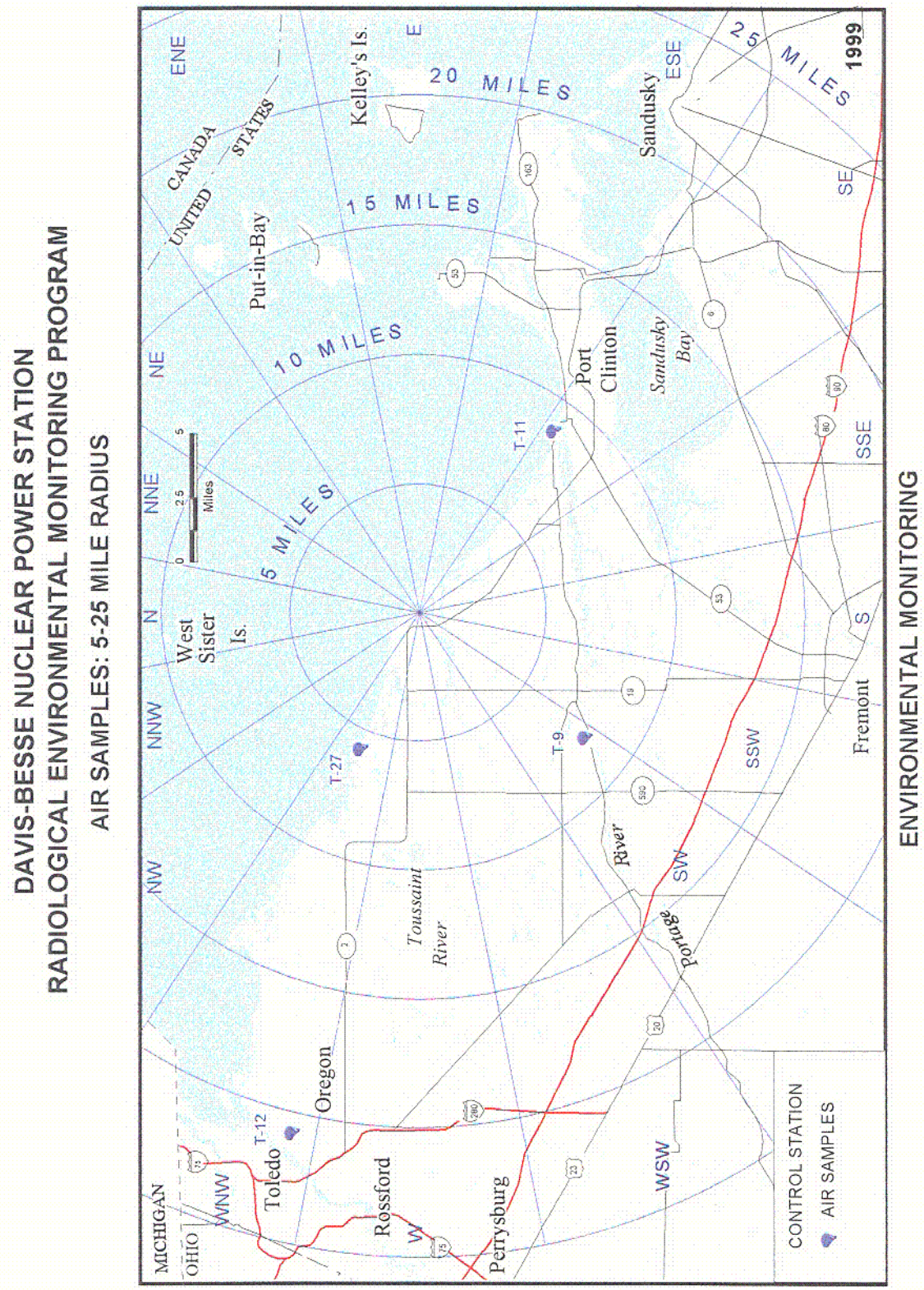

Figure 13: Air Sample 25-mile Map

C-4

Terrestrial Monitoring

The collection and analysis of groundwater, milk, meat, fruits and broad leaf vegetation provides data to assess the buildup of radionuclides that may be ingested by humans. Animal and wildlife feed samples provide additional information on radionuclides that may be present in the food chain. The data from soil sampling provides information on the deposition of radionuclides from the atmosphere.

Many radionuclides are present in the environment due to sources such as cosmic radiation and fallout from nuclear weapons testing. Some of the radionuclides present are:

- **tritium**, present as a result of the interaction of cosmic radiation with the upper atmosphere and as a result of routine release from nuclear facilities
- **beryllium-7**, present as a result of the interaction of cosmic radiation with the upper atmosphere
- **cesium-137**, a man-made radionuclide which has been deposited in the environment, (for example, in surface soils) as a result of fallout from nuclear weapons testing and routine releases from nuclear facilities
- **potassium-40,** a naturally occurring radionuclide normally found throughout the environment (including humans)
- **fallout radionuclides** from nuclear weapons testing, including strontium-89, strontium-90, cesium-137, cerium-141, cerium-144, and ruthenium-106. These radionuclides may also be released in minute amounts from nuclear facilities

The radionuclides listed above are expected to be present in many of the environmental samples collected in the vicinity of the Davis-Besse Station. The contribution of radionuclides from the operation of Davis-Besse is assessed by comparing sample results with preoperational data, operational data from previous years, control location data, and the types and amounts of radioactivity normally released from the Station in liquid and gaseous effluents.

Milk Samples

Milk sampling is a valuable tool in environmental surveillance because it provides a direct basis for assessing the build up of radionuclides in the environment that may be ingested by humans. Milk is collected and analyzed because it is one of the few foods commonly consumed soon after production. The milk pathway involves the deposition of radionuclides from atmospheric releases onto forage consumed by cows. The radionuclides present in the forage eating cow become incorporated into the milk, which is then consumed by humans.

When milk is available, samples are collected at the indicator location and at the control location once a month from November through April, and twice a month from May through October. Sampling is increased in the summer when the herds are usually outside on pasture and not on

stored feed. In December of 1993, the indicator location, T-8, was eliminated from the sampling program because the family there went out of the dairy business and sold the herd. The control location will continue to be sampled monthly in order to gather additional baseline data. If any dairy animals are discovered within five miles of the station, efforts will be made to include them in the milk sampling program.

The 1999 milk samples were analyzed for strontium-89, strontium-90, iodine-131 and other gamma emitting radionuclides, stable calcium and potassium. A total of 12 milk samples were collected in 1999. Strontium-89 was not detected above it's LLD. Strontium-90 was detected in all but one samples collected. The annual average concentration of strontium-90 was 0.9 pCi/l. For all sample sites, the annual average concentration was similar to those measured in the previous years.

Iodine-131 was not detected in any of the milk samples above the LLD of 0.5 pCi/l. The concentrations of barium-140 and cesium-137 were below their respective LLDs in all samples collected.

Since the chemistries of calcium and strontium are similar, as are potassium and cesium, organisms tend to deposit cesium radioisotopes in muscle tissue and strontium radioisotopes in bones. In order to detect the potential environmental accumulation of these radionuclides, the ratios of the strontium radioisotopes radioactivity (pCi/l) to the concentration of calcium (g/l), and cesium radioisotopes radioactivity (pCi/l) to the concentration of potassium (g/l) were monitored in milk. These ratios are compared to standard values to determine if build up is occurring. No statistically significant variations in the ratios were observed.

Table 6: Milk Monitoring Location

Sample Location Number	Type of Location	Location Description
T-24	C	Toft Dairy, Sandusky, 21.0 miles SE of Station

C = Control

Groundwater Samples

Soil acts as a filter and an ion exchange medium for most radionuclides. However, tritium and other radionuclides such as ruthenium-106 have a potential to seep through the soil and could reach groundwater. Davis-Besse does not discharge its liquid effluents directly to the ground. In the past, REMP personnel sampled local wells on a quarterly basis to ensure early detection of any adverse impact on the local groundwater supplies due to Station operation. The wells sampled included two indicator locations (T-7, T-54), and one control location (T-27). In addition, a quality control sample was collected at one of the wells each quarter. The groundwater samples were analyzed for beta emitting radionuclides, tritium, strontium-89, strontium-90 and gamma emitting radionuclides.

During the fall of 1998, the Carroll Township Water Plant was placed into operation, and offered residents a reliable source of high-quality, inexpensive drinking water. This facility has replaced all of the wells within five miles of Davis-Besse, as verified by the Ottawa County Health Department. During the first quarter of 1999, only one Well Water indicator sample (T-54) was available for collection. Beta-emitting radionuclides showed 3.6 pCi/l for this site, while the control location at T-27 averaged <3.0 pCi/l. There was no tritium, Strontium-89, Strontium-90 or gamma-emitting radionuclides above their respective detection limits in any of the samples collected. All sample data were within their normal range, and were similar to previous years.

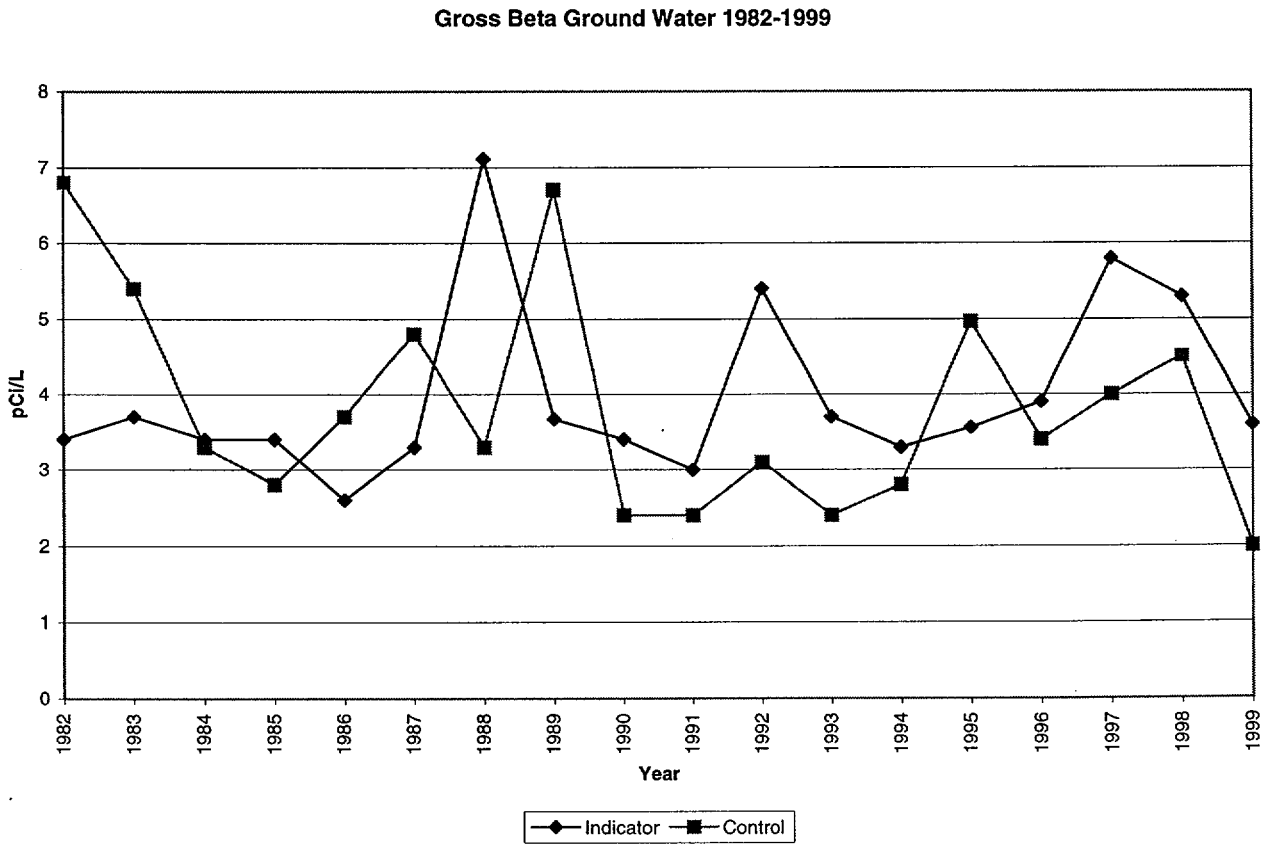

Figure 14: Shown above are the annual averages for gross beta in groundwater from 1982 - 1999.

Table 7: Groundwater Monitoring Locations

Sample Location Number	Type of Location	Location Description
T-27	C	Crane Creek State Park, 5.3 miles WNW of Station
T-54	I	Weis Farm, 4.8 miles SW of Station
T-141	QC	Roving Site

I = indicator C = control QC = quality control

Broadleaf Vegetation and Fruit Samples

Fruits and broadleaf vegetation also represent a direct pathway to humans. Fruits and broadleaf vegetation may become contaminated by deposition of airborne radioactivity (nuclear weapons fallout or airborne releases from nuclear facilities) or from irrigation water drawn from lake water receiving liquid effluents (from hospitals, nuclear facilities, etc.). Radionuclides from the soil may be absorbed by the roots of the plants and become incorporated into the edible portions. During the growing season, edible broadleaf vegetation, such as kale and cabbage, and fruit, such as apples, are collected from farms in the vicinity of Davis-Besse.

In 1999, broadleaf vegetation samples were collected at two indicator locations (T-17 and T-19) and one control location (T-37). Fruit samples were collected at two indicator locations (T-8 and T-25) and one control location (T-209). Broadleaf vegetation was collected once per month during the growing season. Broadleaf vegetation consisted of cabbage. The fruit collected was apples. All samples were analyzed for gamma emitting radionuclides, strontium-89, strontium-90, and iodine-131.

Iodine-131 was not detected above the LLD of 0.024 pCi/g (wet) in any broadleaf vegetation nor above the LLD of 0.021 pCi/g (wet) in fruit samples. The only gamma emitting radionuclide detected in the fruit and broadleaf vegetation samples was potassium-40, which is naturally occurring. In fruit, strontium-89 was detected at T-25 at a concentration of 002 pCi/g(wet), but not above its LLD of 0.001 pCi/g (wet) in the other samples. In broadleaf vegetation, strontium-90 (Sr-90) was detected at average concentrations of 0.002 pCi/g (wet) for indicator locations and below the LLD of 0.002 for control locations. In the fruit samples, Sr-90 at location T-25 (indicator) was .002 pCi/g (wet), while it was not detectable (<.001 pCi/g (wet)) at indicator site T-8 or the control site T-209. All results of analyses were similar to results observed in previous years. This demonstrates that the operation of Davis-Besse had no adverse effect on the surrounding environment in 1999.

Table 8: Broadleaf Vegetation and Fruit Locations

Sample Location Number	Type of Location	Location Description
T-8	I	Moore Farm, 2.7 miles WSW of Station
T-17	I	J. Sobieralski , 1.8 miles SSE of Station
T-19	I	B. Skinner, 1.0 mile W of Station
T-25	I	Witt Farm, 1.6 miles south of Station
T-37	C	Bench Farm, 13.0 miles SW of Station
T-209	C	Roving Control Location

I = indicator C = control

Animal/Wildlife Feed Samples

As with broadleaf vegetation and fruit samples, samples of domestic animal feed, as well as vegetation consumed by wildlife, provide an indication of airborne radionuclides deposited in the vicinity of the Station. Analyses of animal/wildlife feed samples also provide data for determining radionuclide concentration in the food chain. Domestic animals feed samples are collected at two domestic meat-sampling locations. Wildlife feed samples are collected from the Navarre Marsh onsite and from a local marsh within five miles of the Station. As in all terrestrial samples, naturally occurring potassium-40, cosmic ray produced radionuclides such as beryllium-7, and fallout radionuclides from nuclear weapons testing may be present in the feed samples.

- There is one indicator location (T-197) and one control location (T-34). The feed collected was chicken feed. All samples were analyzed for gamma emitting radionuclides.
- Wildlife feed was collected annually at three locations (T-31, T-32 and T-198). The samples consisted of the edible portions of cattails and smartweed. Samples were analyzed for gamma emitting radionuclides.

In both the animal and wildlife feed, naturally occurring potassium-40 was detected. Beryllium-7 was detected at T-32, but not in any of the other samples. All other radionuclides were below their respective LLDs. The operation of Davis-Besse had no adverse effect on the surrounding environment.

Table 9: Animal/Wildlife Feed Locations

Sample Location Number	Type of Location	Location Description
T-31	I	Davis-Besse, onsite roving location
T-32	C	Metzer Marsh, 10.0 miles WNW of the Station
T-34	C	Hemminger residence, 9 miles W of the Station
T-197	I	Lochotzki residence 4.0 miles W of the Station Lemon Road
T-198	I	Toussaint Creek Wildlife Area 4.0 miles WSW of the Station

I = indicator C = control

Wild and Domestic Meat Samples

Sampling of domestic and wild meat provides information on environmental radionuclide concentrations that humans may be exposed to through an ingestion pathway. The principle pathways for radionuclide contamination of meat animals include deposition of airborne radioactivity in their food and drinking water and contamination of their drinking water from radionuclides released in liquid effluents.

The REMP generally collects wild meat and domestic meat (chickens) on an annual basis. Wild animals commonly consumed by residents in the vicinity of Davis-Besse include waterfowl, deer, rabbits and muskrats. Analyses from these animals provide general information on radionuclide concentration in the food chain. When evaluating the results from analyses performed on meat animals, it is important to consider the age, diet and mobility of the animal before drawing conclusions on radionuclides concentration in the local environment or in a species as a whole.

Domestic meat samples were sampled in 1999 as follows:

- Domestic Meat: Chickens were collected at one indicator location (T-197) and one control location (T-34). The samples were analyzed for gamma emitting nuclides.
- Wild Meat: Muskrat samples were obtained from one location onsite (T-31).

  (only natural occurring radionuclides were detected in the edible portion of chickens and muskrat)

Table 10: Wild and Domestic Meat Locations

Sample Location Number	Type of Location	Location Description
T-31	I	Onsite roving location
T-34	C	Hemminger residence, Wallbridge Rd, 9 miles W of the Station
T-197	I	Lochotzki residence, 4.0 miles W of the Station Lemon Road

I = indicator C = control

Soil Samples

Soil samples are generally collected twice a year at the sites that are also equipped with air samplers. Only the top layer of soil is sampled in an effort to identify possible trends in the local environmental nuclide concentration caused by atmospheric deposition of fallout and station released radionuclides. Generally, the sites are relatively undisturbed, so that the sample will be representative of the actual deposition in the area. Ideally, there should be little or no vegetation present, because the vegetation could affect the results of analyses. Approximately five pounds of soil are taken from the top two inches at each site. Many naturally occurring radionuclides such as beryllium-7 (Be-7) and potassium-40 (K-40) and fallout radionuclides from nuclear weapons testing are detected. Fallout radionuclides that are often detected include strontium-90 (Sr-90), cesium-137 (Cs-137), cerium-141 (Ce-141) and ruthenium-106 (Ru-106).

During 1999, soil was collected at ten sites in April and October. The indicator locations included T-1, T-2, T-3, T-4, T-7, and T-8. The control locations were T-9, T-11, T-12, and T-27. All soil samples were analyzed for gamma emitting radionuclides. The results show that the only gamma emitter detected in addition to naturally occurring Be-7 and K-40, was Cs-137. Cs-137 was found in both indicator and control locations at average concentrations of 0.35 pCi/g dry and 0.18 pCi/g dry, respectively. The concentrations were similar to that observed in previous years (Figure15).

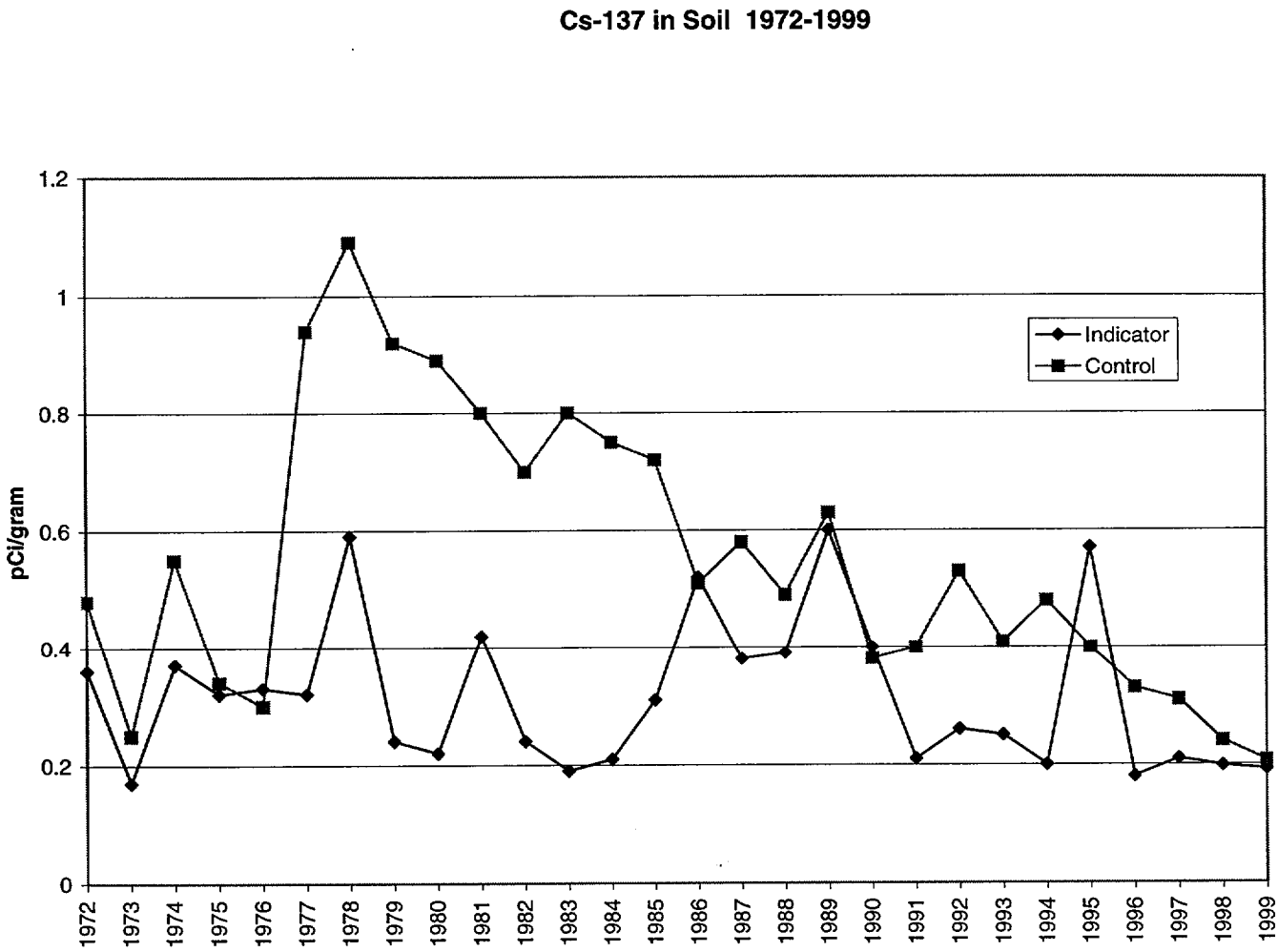

Figure 15: The concentration of cesium-137 in soil has remained fairly constant over the years REMP has been conducted. The peak seen in 1978 was due to fallout from nuclear weapons testing.

Table 11: Soil Locations

Sample Location Number	Type of Location	Location Description
T-1	I	Site boundary, 0.6 miles ENE of Station
T-2	I	Site boundary, 0.9 miles E of Station
T-3	I	Site boundary 1.4 miles ESE of Station
T-4	I	Site boundary 0.8 miles S of Station
T-7	I	Sand Beach, main entrance, 0.9 miles NW of Station
T-8	I	Moore Farm, 2.7 miles WSW of Station
T-9	C	Oak Harbor Substation, 6.8 miles SW of Station
T-11	C	Port Clinton Water Treatment Plant, 9.5 miles SE of Station
T-12	C	Toledo Water Treatment Plant, 23.5 miles WNW of Station
T-27	C	Crane Creek State Park, 5.3 miles WNW of Station

I = indicator C = control

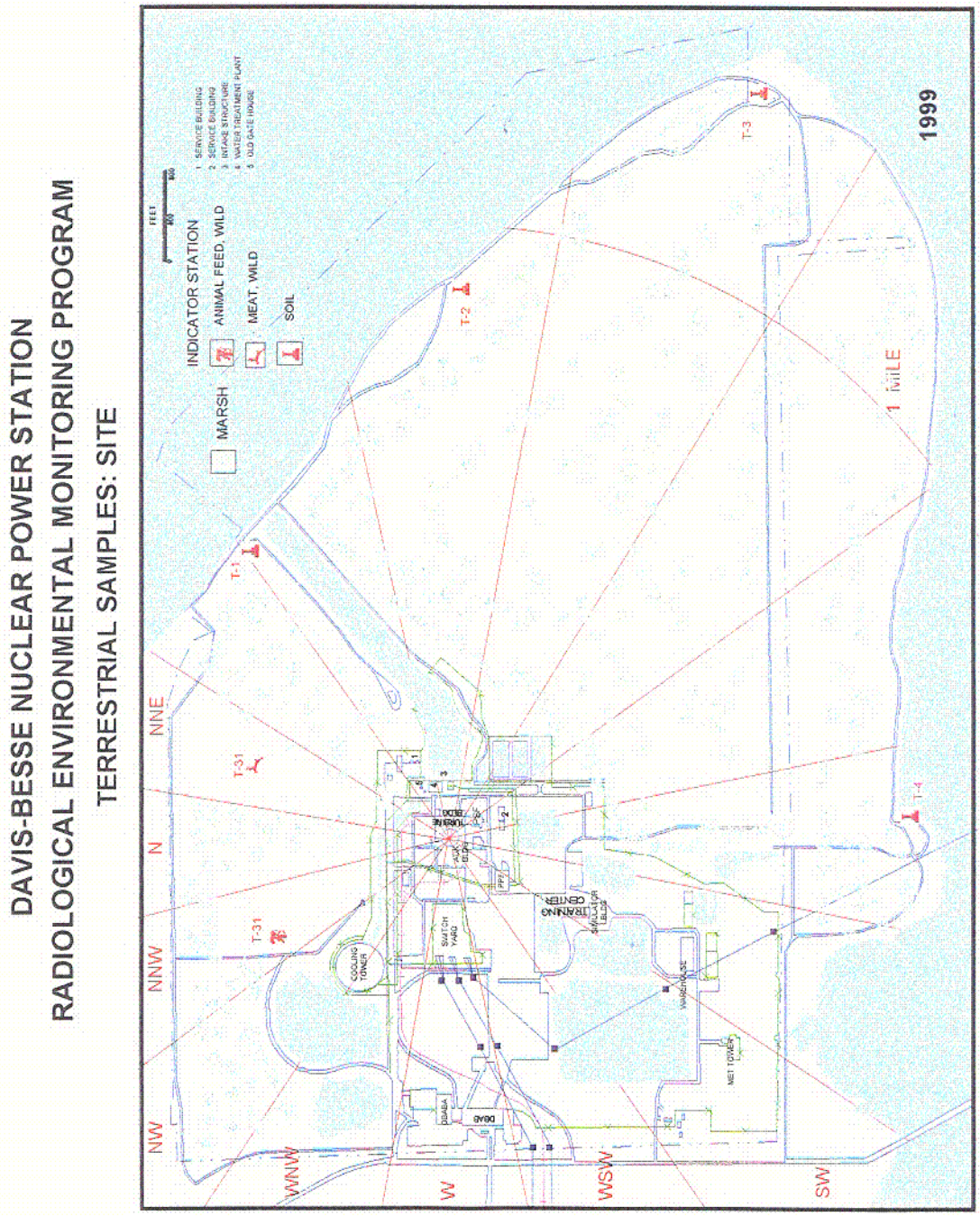

Figure 16: Terrestrial Site Map

C-5

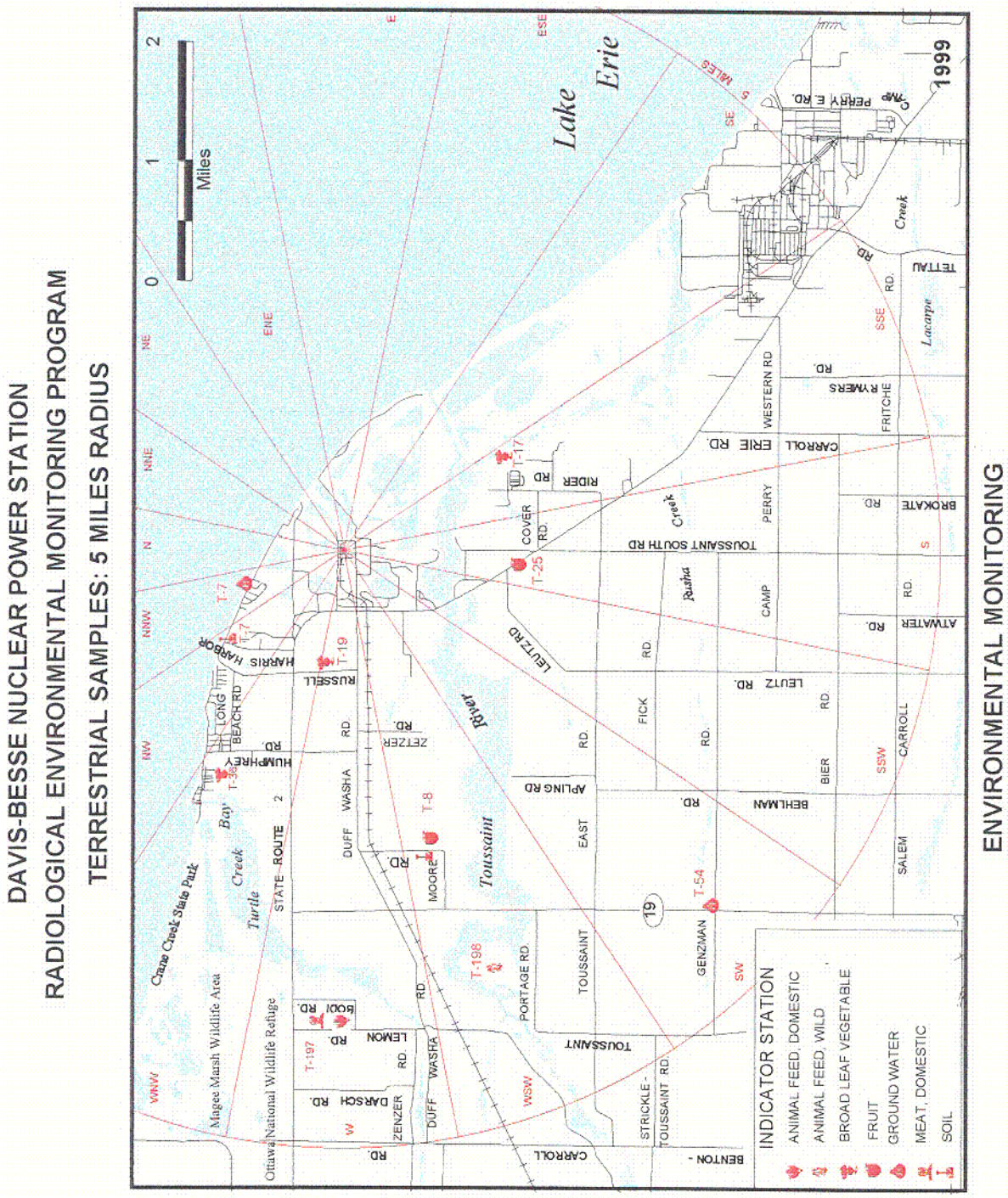

Figure 17: Terrestrial 5-mile Map

C-6

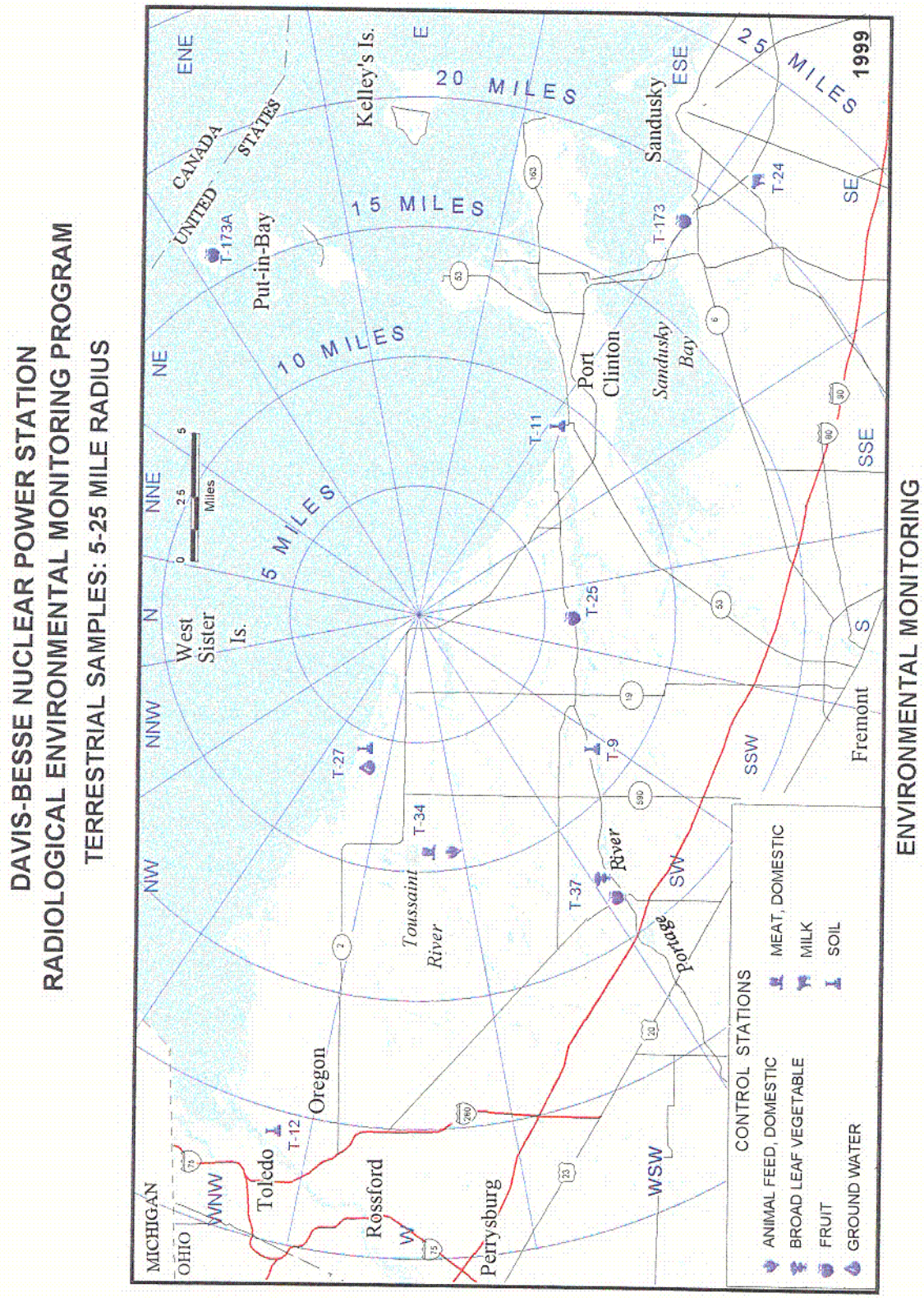

Figure 18: Terrestrial 25-mile Map

C-7

Aquatic Monitoring

Radionuclides may be present in Lake Erie from many sources including atmospheric deposition, run-off/soil erosion, and releases of radioactive material in liquid effluents from hospitals or nuclear facilities. These sources provide two forms of potential exposure to radiation, external and internal. External exposure can occur from the surface of the water, shoreline sediments and from immersion (swimming) in the water. Internal exposure can occur from ingestion of radionuclides, either directly from drinking water, or as a result of the transfer of radionuclides through the aquatic food chain with eventual consumption of aquatic organisms, such as fish. To monitor these pathways, Davis-Besse samples treated surface water (drinking water), untreated surface water (lake or river water), fish, and shoreline sediments.

Treated Surface Water

Treated surface water is water from Lake Erie, which has been processed for human consumption. Radiochemical analysis of this processed water provides a direct basis for assessing the dose to humans from ingestion of drinking water.

Samples of treated surface water were collected from two indicators (T-22B and T-50) and two control locations (T-11 and T-12A). These locations include the water treatment facilities for Carroll Township, Erie Industrial Park, Port Clinton and Toledo. Samples were collected weekly and composited monthly. The monthly composites were analyzed for beta emitting radionuclides. The samples were also composited in a quarterly sample and analyzed for strontium-89, strontium-90, gamma emitting radionuclides, and tritium. One QC sample was collected from a routine location, which was changed each month.

The annual average of beta-emitting radionuclides for indicator and control locations was 2.5 pCi/l and 2.5 pCi/l, respectively. These results are similar to previous years as shown in Figure 19. Tritium was detected above the LLD of 330 pCi/l at two locations during January, at T-50 and T-11. The concentration at T-50 was 446 pCi/l and 337 pCi/l at T-11. Strontium-89 was not detected above the LLD 1.5 pCi/l. Strontium-90 activity was not detected above its LLD of 0.77 pCi/l except at T-50, where a value of 0.9 pCi/l was detected in the 4th quarter. These results are similar to those of previous years and indicate no adverse impact on the environment resulting form the operation of Davis-Besse in 1999.

Each month, weekly quality control samples were collected at different locations. The results of the analyses from the quality control samples were consistent with the routine samples. The average concentration of beta emitting radionuclides detected at the QC location was 2.5 pCi/l and 2.5 pCi/l at routine locations. Cesium-137 was below its LLD. Tritium was detected at just above the LLD during January and December at 337 and 359 pCi/l at QC points. There was good agreement between the routine and QC locations.

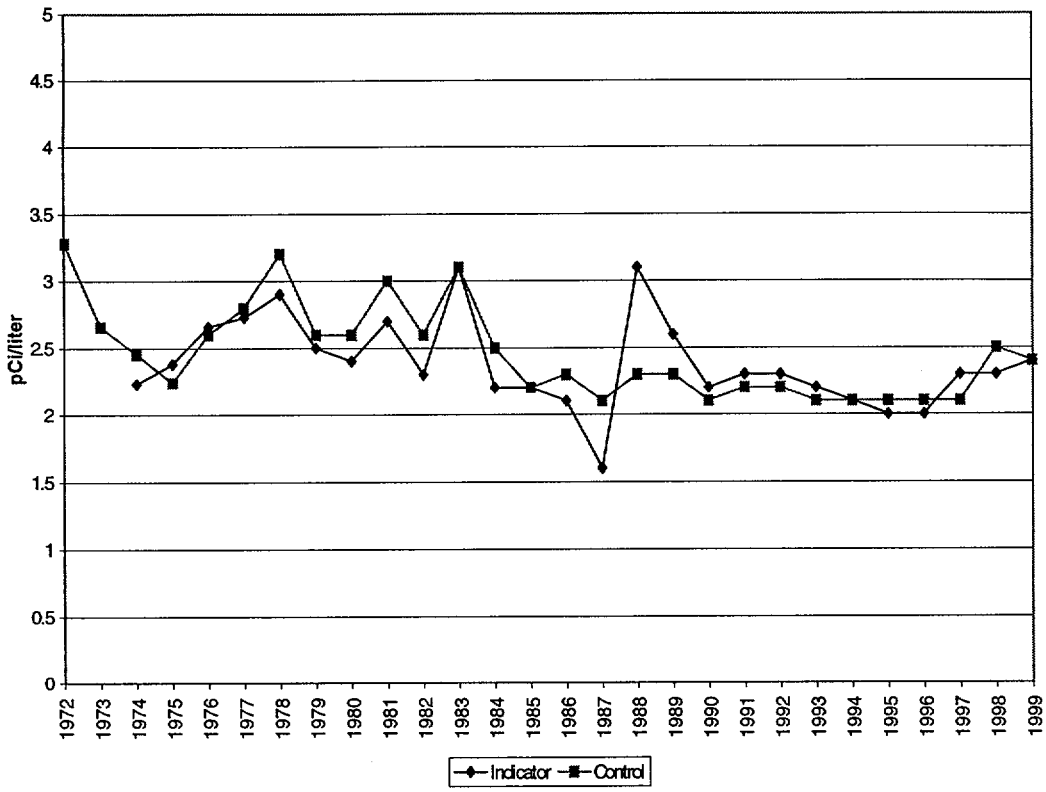

Figure 19: Since 1974, the annual concentrations of beta emitting radionuclides in treated surface water samples collected from indicator locations have been consistent with those from control locations. This shows that Davis-Besse has had no measurable radiological impact on surface water used to make drinking water.

Table 12: Treated Surface Water Locations

Sample Location Number	Type of Location	Location Description
T-11	C	Port Clinton Water Treatment Plant 9.5 miles SE of Station
T-12	C	Toledo Water Treatment Plant 23.5 miles WNW of Station
T-22B	I	Carroll Township water sampled at Davis-Besse
T-50	I	Erie Industrial Park, Port Clinton, 4.5 miles SE of Station
T-143	QC	Quality Control Site

I = indicator C = control QC = quality control

Untreated Surface Water

Sampling and analysis of untreated surface water provides a method of assessing the dose to humans from external exposure from the lake surface as well as immersion in the water. It also provides information on the radionuclides present which may affect drinking water, fish, and irrigated crops.

Routine Program

The routine program is the basic sampling program which is performed year round. Untreated water samples are collected in the areas of the station intake and discharge and at the water intakes used by nearby water treatment plants. Routine samples are collected at Port Clinton, Toledo, Carroll Township Intake and Erie Industrial Park. A sample is also collected from Lake Erie at the mouth of the Toussaint River. These samples are collected weekly and composited monthly. The monthly composite is analyzed for beta emitting radionuclides, tritium, and gamma emitting radionuclides. The samples are further composited quarterly and analyzed for strontium-89 and strontium-90. A QC sample is also collected weekly. It is at a different location each month.

Summer Program

The summer program is designed to supplement the routine untreated water sampling program in order to provide a more comprehensive study during the months of high lake recreational activity, such as boating, fishing, and swimming. These samples are obtained in areas along the shoreline of Lake Erie. The samples are collected monthly and analyzed for beta emitting radioactivity, tritium, strontium-89, strontium-90 and gamma emitting radionuclides.

For the routine samples composited weekly, the beta emitting radionuclides had an average concentration of 2.6 pCi/l at indicator and 2.4 pCi/l at control locations respectively. The average concentration of beta emitting radionuclides in all samples (including lake water) was 2.5 pCi/l at indication and 2.5 pCi/l at control locations.

During 1999, tritium was detected in 11 untreated surface water samples. Ten samples ranged between 337 and 550 pCi/l. The eleventh, a control sample located 5.8 miles WNW of the station, measured 5288 pCi/l. The tritium in this sample is not thought to be from the operation of Davis-Besse for the following reasons: a) this control sample point is upstream of Davis-Besse, b) two indicator samples collected between this location and the plant showed no detectable tritium activity and, c) tritium was not detected in a subsequent sample taken at this location.

Cesium-137 was not detectable in samples of untreated water above the LLD of 9 pCi/l.

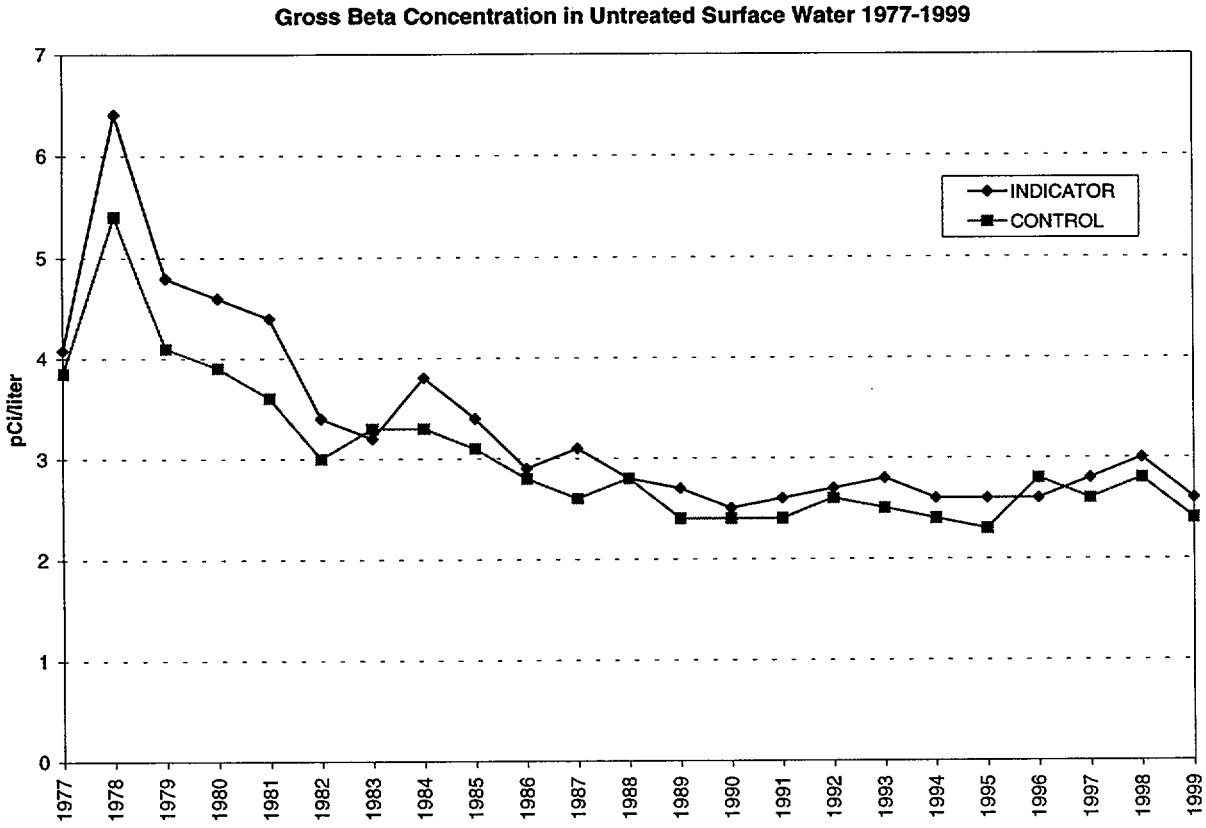

Figure 20: The average concentration of beta emitting radionuclides in untreated water was similar between control and indicator locations. This demonstrates that Davis-Besse had no radiological impact on the surrounding environment.

Each month, weekly quality control samples were collected at different locations. The results of the analyses from the quality control samples were consistent with the routine samples. The average concentration of beta emitting radionuclides detected at the QC location was 2.8 pCi/l and 2.8 pCi/l at routine locations. Tritium and cesium-137 were below their respective LLDs. There was good agreement between the routine and QC locations.

Table 13: Untreated Surface Water Locations

Sample Location Number	Type of Location	Location Description
T-3	I	Site boundary, 1.4 miles ESE of Station
T-11	C	Port Clinton Water Treatment Plant, 9.5 miles SE of Station
T-12	C	Toledo Water Treatment Plant, sample taken from intake crib, 11.25 miles NW of Station
T-22A	I	Carroll Township Water Intake, Humphrey Rd., 3.0 miles NW of Station
T-50	I	Erie Industrial Park, Port Clinton, 4.5 miles SE of Station
T-131	I	Lake Erie, 0.8 miles NE of Station
T-132	I	Lake Erie, 1.0 miles E of Station
T-133	I	Lake Erie, 0.8 miles N of Station
T-134	I	Lake Erie, 1.4 miles NW of Station
T-135	I	Lake Erie, 2.5 miles WNW of Station
T-137	C	Lake Erie, 5.8 miles WNW of Station
T-145	QC	Roving Quality Control Site
T-152	C	Lake Erie, 15.6 miles WNW of Station
T-158	C	Lake Erie, 10.0 miles WNW of Station
T-162	C	Lake Erie, 5.4 miles SE of Station
T-167	C	Lake Erie, 11.5 miles E of Station

I = indicator C = control

Shoreline Sediment

The sampling of shoreline sediments can provide an indication of the accumulation of undissolved radionuclides which may lead to internal exposure to humans through the ingestion of fish, through resuspension into drinking water supplies, or as an external radiation source from shoreline exposure to fishermen and swimmers.

Samples of deposited sediments in water along the shore were collected at various times from three indicator sites (T-3, T-4, and T-132) and one control location (T-27). Shoreline sediment was collected with a shovel. All samples were analyzed for gamma emitting radionuclides. Naturally occurring potassium-40 was detected at both control and indicator locations. Cs-137 was detected at one location, T-4 at a concentration of 0.27 pCi/g. These results are similar to previous years.

Table 14: Shoreline Sediment Locations

Sample Location Number	Type of Location	Location Description
T-3	I	Site boundary, 1.4 miles ESE of Station
T-4	I	Site boundary, 0.8 miles S of Station
T-27	C	Crane Creek State Park, 5.3 miles WNW of Station
T-132	I	Lake Erie, 1.0 miles E of Station

I = indicator C = control

Fish Sample

Fish are analyzed primarily to quantify the dietary radionuclide intake by humans, and secondarily to serve as indicators of radioactivity in the aquatic ecosystem. The principal nuclides which may be detected in fish include naturally occurring potassium-40, as well as cesium-137, and strontium-90. Depending upon the feeding habit of the species (e.g., bottom-feeder versus predator), results from sample analyses may vary.

With the aid of a local commercial fisherman, Davis-Besse routinely collects three species of fish (walleye, white perch or white bass and carp) once a year from sampling locations near the Station's liquid discharge point and more than ten miles away from the Station where fish populations would not be expected to be impacted by the Station operation. Walleye are collected because they are a popular sport fish and white perch or white bass are collected because they are an important commercial fish. Carp are collected because they are bottom feeders where contaminants may settle.

The average concentration of beta emitting radionuclides in fish was similar for indicator and control locations (3.13 pCi/g and 2.78 pCi/g wet weight, respectively). Cesium-137 was not detected above the LLD of <0.018 pCi/g for indicator and control locations. No other gamma emitters were detected above their respective LLDs.

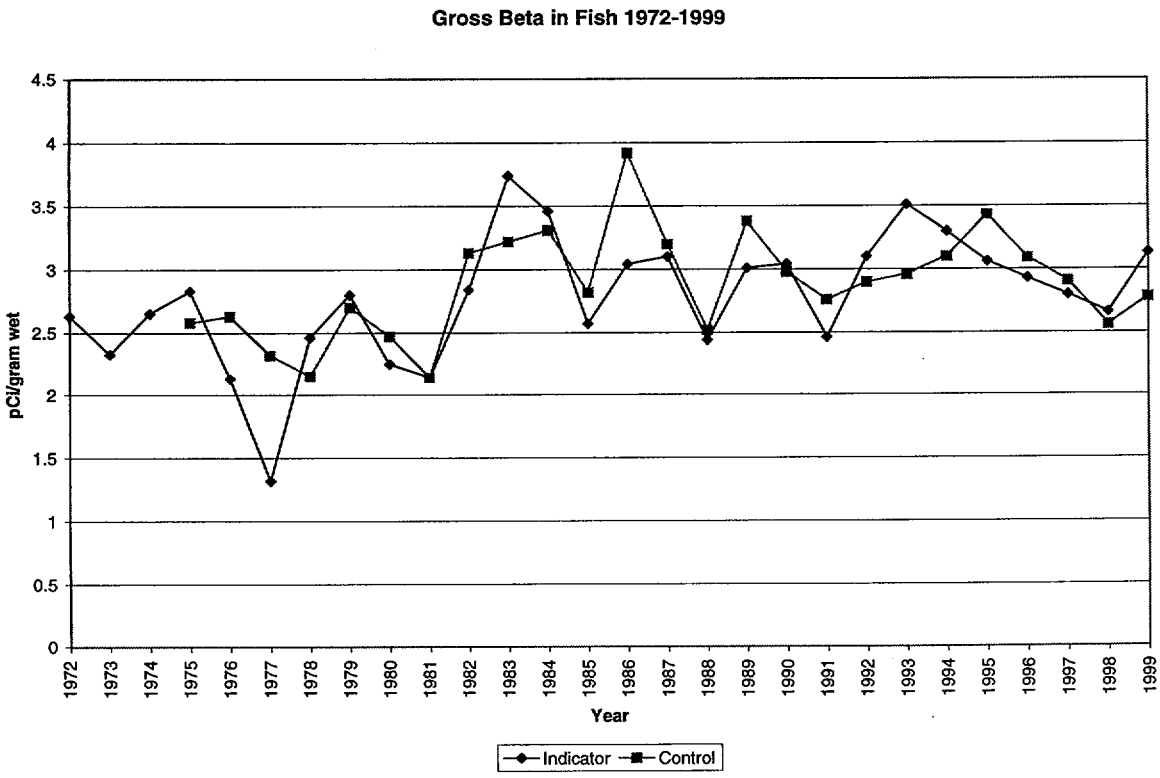

Figure 21: Average concentrations of beta emitting radionuclides in fish samples were similar at indicator and control locations and were within the range of results of previous years.

Table 15: Fish Locations

Sample Location Number	Type of Location	Location Description
T-33	I	Lake Erie, within 5 miles radius of Station
T-35	C	Lake Erie, greater than 10 mile radius of Station

I = indicator C= control

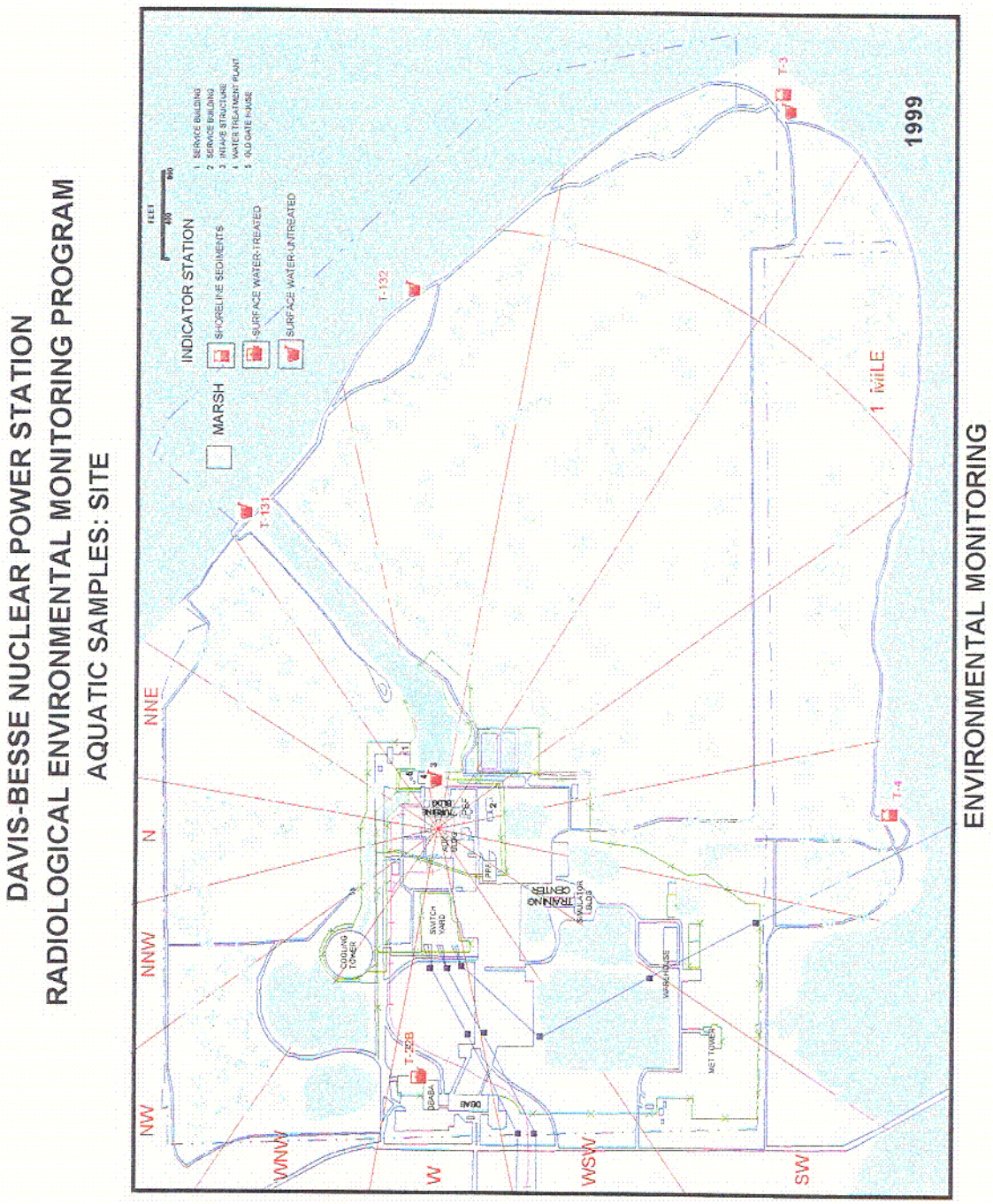

Figure 22: Aquatic Site Map

C-8

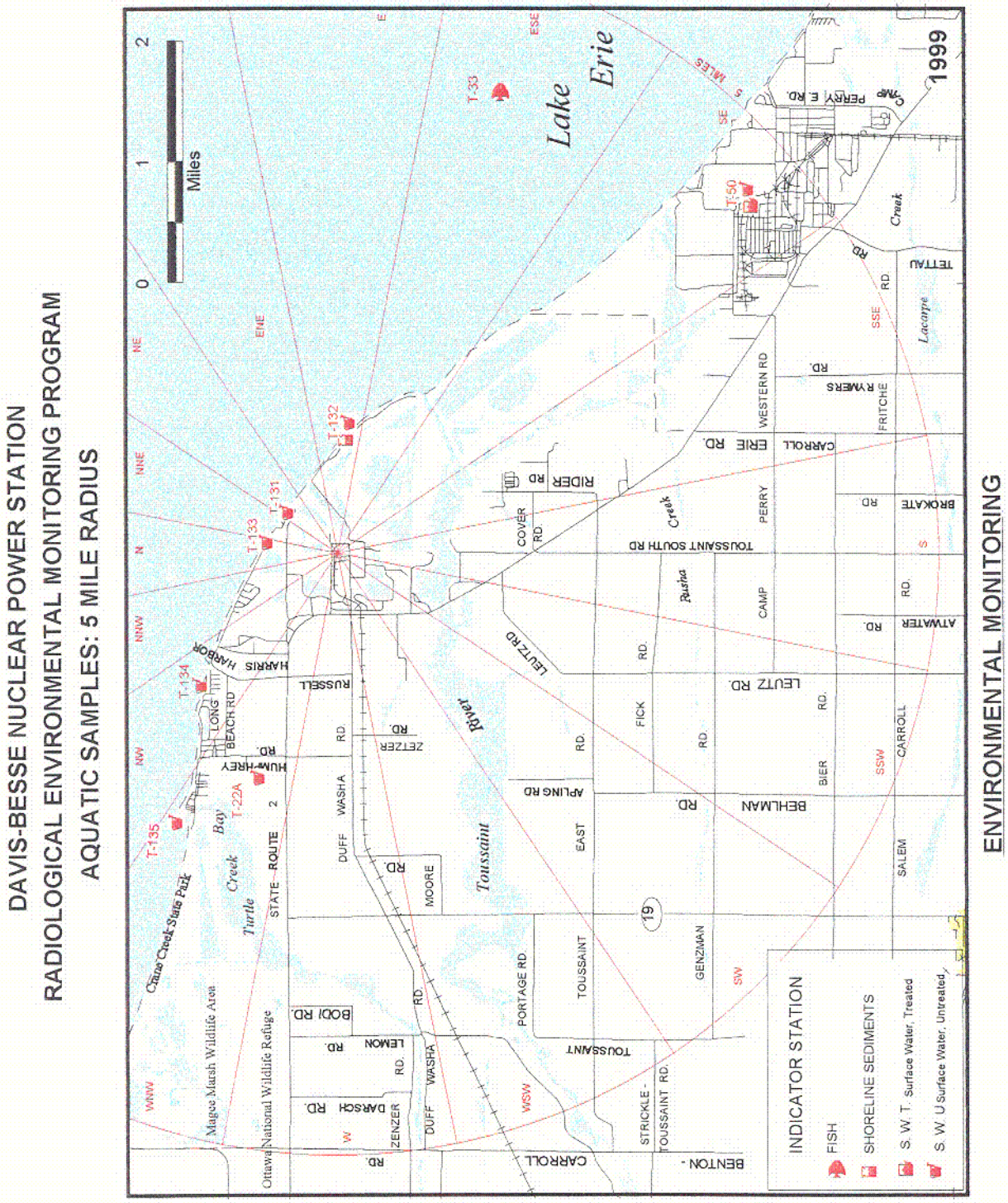

Figure 23: Aquatic 5-mile Map

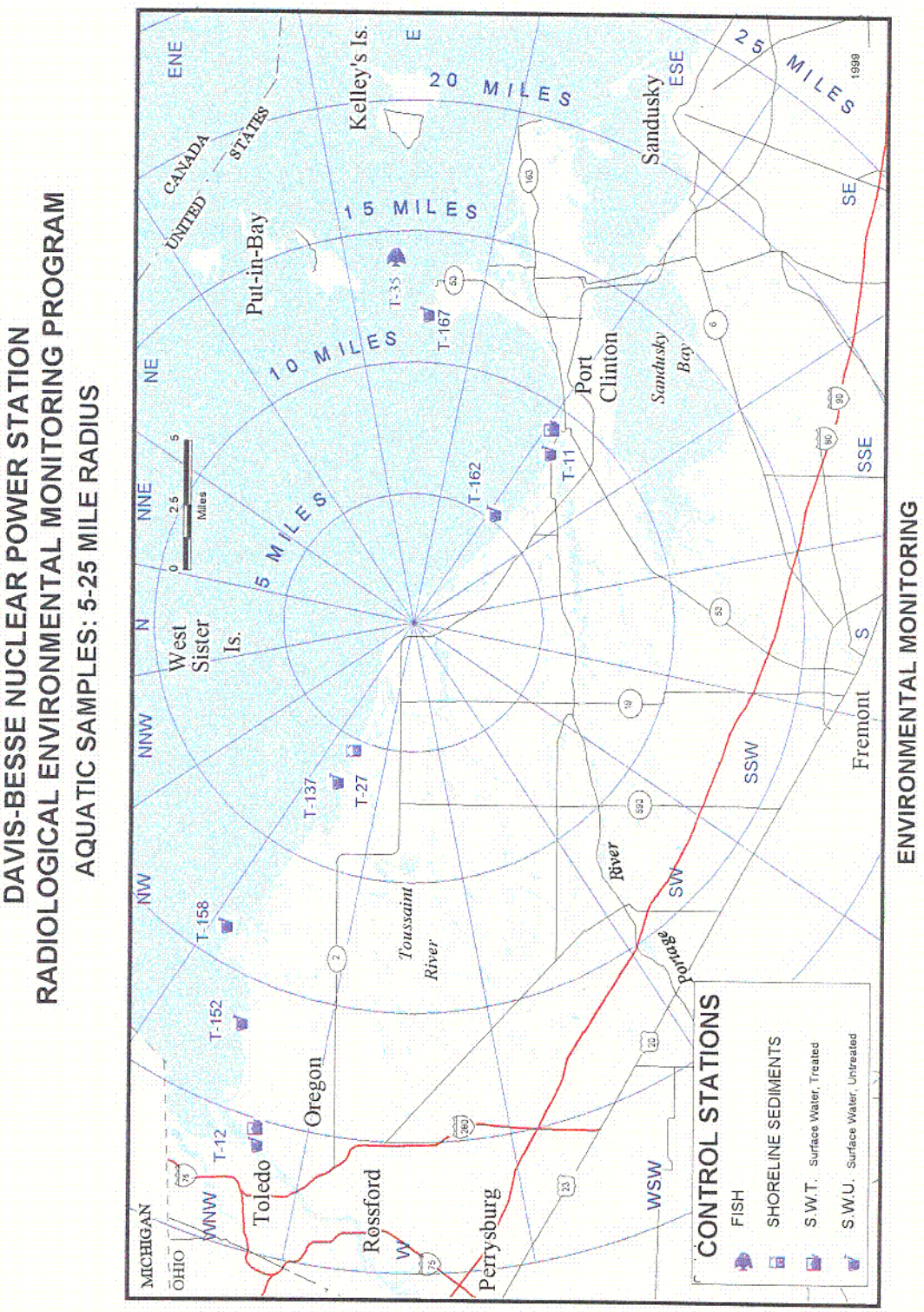

Figure 24: Aquatic 25-mile Map

C-10

Direct Radiation Monitoring

Thermoluminescent Dosimeters

Radionuclides present in the air and deposited on the ground may directly irradiate individuals. Direct radiation levels at and around Davis-Besse are constantly monitored by thermoluminescent dosimeters (TLDs). TLDs are small devices which store radiation dose information. The TLDs used at Davis-Besse contain a calcium sulfate: dysprosium ($CaSO_4$:Dy) card with four main readout areas. Multiple readout areas are used to ensure the precision of the measurements.

Thermoluminescence is a process by which ionizing radiation interacts with phosphor which is the sensitive material in the TLD. Energy is trapped in the TLD material and can be stored for several months or years. This provides an excellent method to measure the dose received over long periods of time. The energy that was stored in the TLD as a result of interaction with radiation is released and measured by a controlled heating process in a calibrated reading system. As the TLD is heated, the phosphor releases the stored energy in the form of light. The amount of light detected is directly proportional to the amount of radiation to which the TLD was exposed. The reading process re-zeroes the TLD and prepares it for reuse.

TLD Collection

Davis-Besse has 75 TLD locations (64 indicator and 11 control) which are collected and replaced on a quarterly and annual basis. Eighteen QC TLDs are also collected on a quarterly and annual basis. There are a total of 186 TLDs in the environment surrounding Davis-Besse at any given time. By collecting TLDs on a quarterly and annual basis from a single site, each measurement serves as a quality control check on the other. Over 98% of the quarterly TLDs placed in the field and 95% of the annual TLDs placed in the field were retrieved and evaluated during the current reporting period.

In 1999, the average dose equivalent for quarterly TLDs at all indicator locations was 14 mrem/91 days, and for all control locations was 15.1 mrem/91 days. The average dose equivalent for annual TLDs in 1999 was 53.3 mrem/365 days at indicator locations and 59.7 mrem/365 days for control locations.

Quality Control TLDs

Duplicate TLDs have been placed at 18 sites. These TLDs were placed in the field at the same time and at the same location as some of the routine TLDs, but were assigned quality control site numbers. This allows us to take several measurements at the location without the laboratory being aware that they are the same. A comparison of the quality control and routine results provides a method to check the accuracy of the measurements. The average dose equivalent at the routine TLDs averaged 14.4 mrem/91 days while the quality control TLDs yielded an average dose equivalent of 13.3 mrem/91 days. All the quality control and routine sample results were similar, demonstrating the accuracy of both the TLDs and the laboratory's measurements.

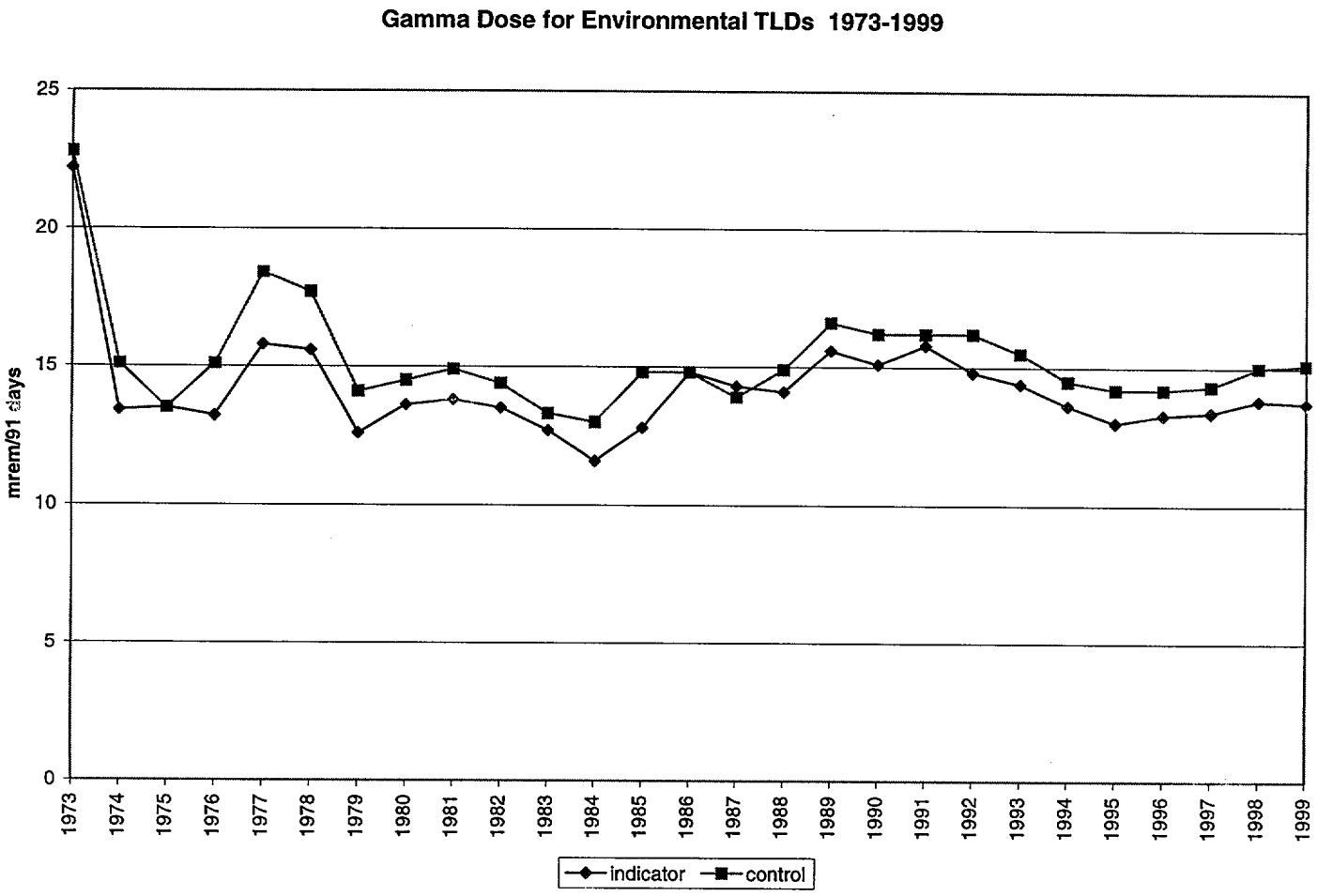

Figure 25: The similarity between indicator and control results demonstrated that the operation of Davis-Besse has not caused any abnormal gamma dose.

Table 16: Thermoluminescent Dosimeter Locations

Sample Location Number	Type of Location	Location Description
T-1	I	Site boundary, 0.6 miles ENE of Station
T-2	I	Site boundary, 0.9 miles E of Station
T-3	I	Site boundary, 1.4 miles ESE of Station
T-4	I	Site boundary, 0.8 miles S of Station
T-5	I	Site boundary, 0.5 miles W of Station
T-6	I	Site boundary, 0.5 miles NNE of Station
T-7	I	Sand Beach, main entrance, 0.9 miles NW of Station
T-8	I	Earl Moore Farm, 2.7 miles WSW of Station
T-9	C	Oak Harbor Substation, 6.8 miles SW of Station
T-10	I	Site boundary, 0.5 miles SSW of Station near warehouse
T-11	C	Port Clinton Water Treatment Plant, 9.5 miles SE of Station
T-12	C	Toledo Water Treatment Plant, 23.5 miles WNW of Station
T-24	C	Sandusky, 21.0 miles SE of Station
T-27	C	Crane Creek State Park, 5.3 miles WNW of Station
T-38	I	Site boundary, 0.6 miles ENE of Station
T-39	I	Site boundary 1.2 miles ENE of Station
T-40	I	Site boundary, 0.7 miles SE of Station
T-41	I	Site boundary, 0.6 miles SSE of Station
T-42	I	Site boundary, 0.8 miles SW of Station

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
T-43	I	Site boundary, 0.5 miles SW of Station
T-44	I	Site boundary, 0.5 miles WSW of Station
T-45	I	Site boundary, 0.5 miles WNW of Station
T-46	I	Site boundary, 0.5 miles NW of Station
T-47	I	Site boundary, 0.5 miles N of Station
T-48	I	Site boundary, 0.5 miles NE of Station
T-49	I	Site boundary, 0.5 miles NE of Station
T-50	I	Erie Industrial Park, Port Clinton, 4.5 miles SE of Station
T-51	C	on Siren Pole, 5.5 miles SSE of Station
T-52	I	Miller Farm, 3.7 miles S of Station
T-53	I	Nixon Farm, 4.5 miles S of Station
T-54	I	Weis Farm, 4.8 miles SW of Station
T-55	I	King Farm, 4.5 miles W of Station
T-60	I	Site boundary, 0.3 miles S of Station
T-62	I	Site boundary, 1.0 mile SE of Station
T-63	I	Site boundary, 1.1 miles ESE of Station
T-65	I	Site boundary, 0.3 miles E of Station
T-66	I	Site boundary, 0.3 miles ENE of Station
T-67	I	Site boundary, 0.3 miles NNW of Station
T-68	I	Site boundary, 0.5 miles WNW of Station
T-69	I	Site boundary, 0.4 miles W of Station

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
T-71	I	Site boundary, 0.1 mile NNW of Station
T-73	I	Site boundary, 0.1 mile WSW of Station
T-74	I	Site boundary, 0.1 mile SSW of Station
T-75	I	Site boundary, 0.2 mile SSE of Station
T-76	I	Site boundary, 0.1 mile SE of Station
T-80	QC	Quality Control Site
T-81	QC	Quality Control Site
T-82	QC	Quality Control Site
T-83	QC	Quality Control Site
T-84	QC	Quality Control Site
T-85	QC	Quality Control Site
T-86	QC	Quality Control Site
T-88	QC	Quality Control Site
T-87	QC	Quality Control currently located in lead pig, DBAB annex
T-89	QC	Quality Control Site
T-91	I	State Route 2 and Rankie Road, 2.5 miles SSE of Station
T-92	I	Locust Point Road, 2.7 miles WNW of Station
T-93	I	Twelfth Street, Sand Beach, 0.6 miles NNE of Station
T-94	I	State Route 2, 1.8 miles WNW of Station
T-95	C	State Route 579, 9.3 miles W of Station

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
T-100	C	Ottawa County Highway Garage, Oak Harbor, 6.0 miles S of Station
T-111	C	Toussaint North Road, 8.3 miles WSW of Station
T-112	I	Thompson Road, 1.5 miles SSW of Station
T-113	QC	Quality Control Site
T-114	QC	Quality Control Site
T-115	QC	Quality Control Site
T-116	QC	Quality Control Site
T-117	QC	Quality Control Site
T-118	QC	Quality Control Site
T-119	QC	Quality Control Site
T-120	QC	Quality Control Site
T-121	I	State Route 19, 2.0 miles W of Station
T-122	I	Duff Washa and Humphrey Road, 1.7 miles W of Station
T-123	I	Zetzer Road, 1.6 miles WSW of Station
T-124	C	Church and Walnut Street, Oak Harbor, 6.5 miles SSW of Station
T-125	I	Behlman and Bier Roads, 4.4 miles SSW of Station
T-126	I	Camp Perry Western and Toussaint South Road, 3.7 miles S of Station
T-127	I	Camp Perry Western and Rymers Road, 4.0 miles SSE of Station

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
T-128	I	Erie Industrial Park, Port Clinton Road, 4.0 miles SE of Station
T-142	I	Site Boundary, 0.8 miles SSE of Station
T-150	I	Humphrey and Hollywood Road, 2.1 miles NW of Station
T-151	I	State Route 2 and Humphrey Road, 1.8 miles WNW of Station
T-153	I	Leutz Road, 1.4 miles SSW of Station
T-154	I	State Route 2, 0.7 miles SW of Station
T-155	C	Fourth and Madison Streets, Port Clinton, 9.5 miles SE of Station
T-200	QC	Quality Control Site
T-201	I	Sand Beach, 1.1 miles NNW of Station
T-202	I	Sand Beach 0.8 miles NNW of Station
T-203	I	Sand Beach, 0.7 miles N of Station
T-204	I	Sand Beach, 0.7 miles N of Station
T-205	I	Sand Beach, 0.5 miles NNE of Station
T-206	I	Site Boundary, 0.6 miles NW of Station
T-207	I	Site Boundary, 0.5 miles N of Station
T-208	I	Site Boundary, 0.5 miles NNE of Station.

I = indicator C = control QC = quality control

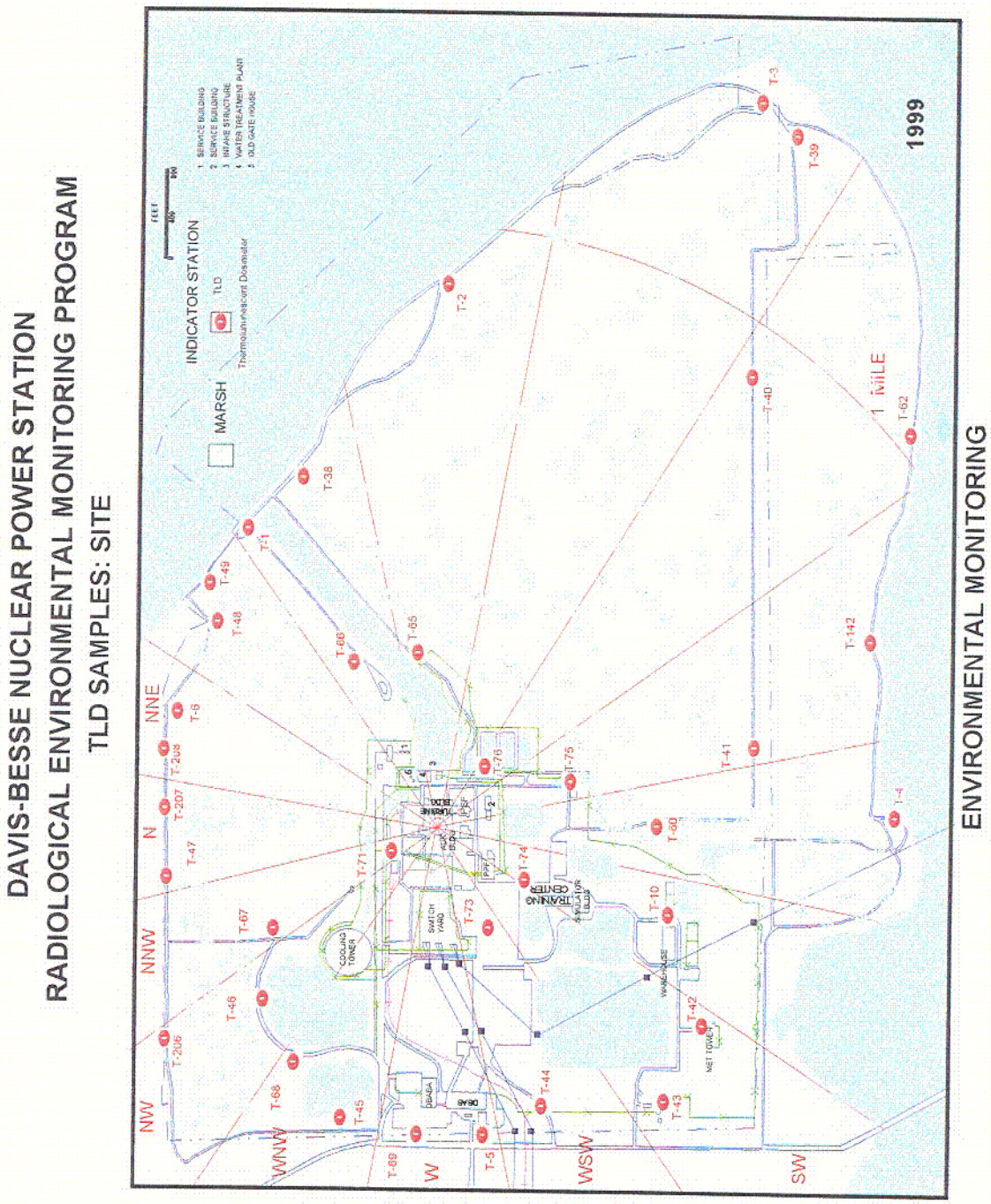

Figure 27: TLD Site Map

C-11

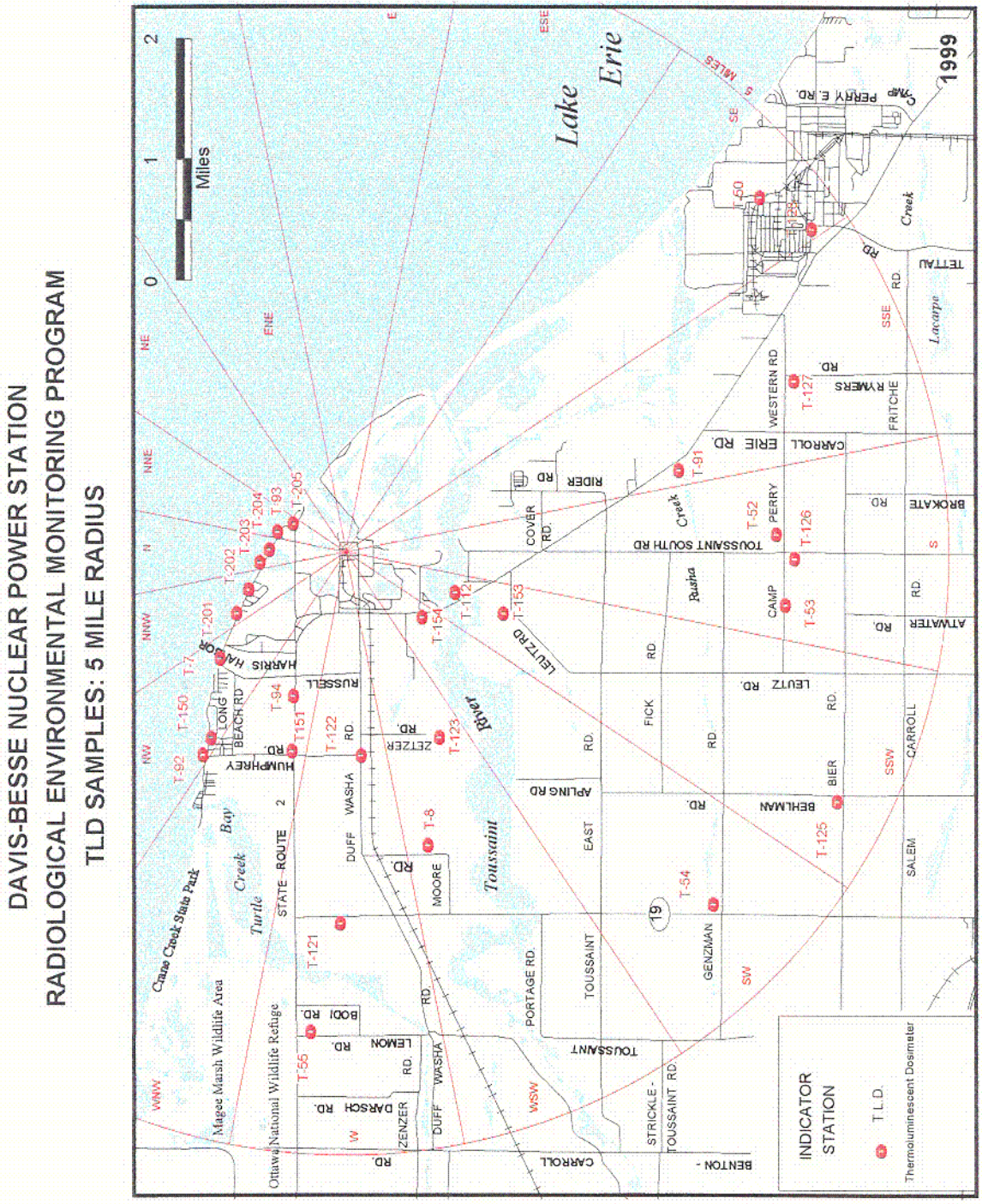

Figure 28: TLD 5-mile Map

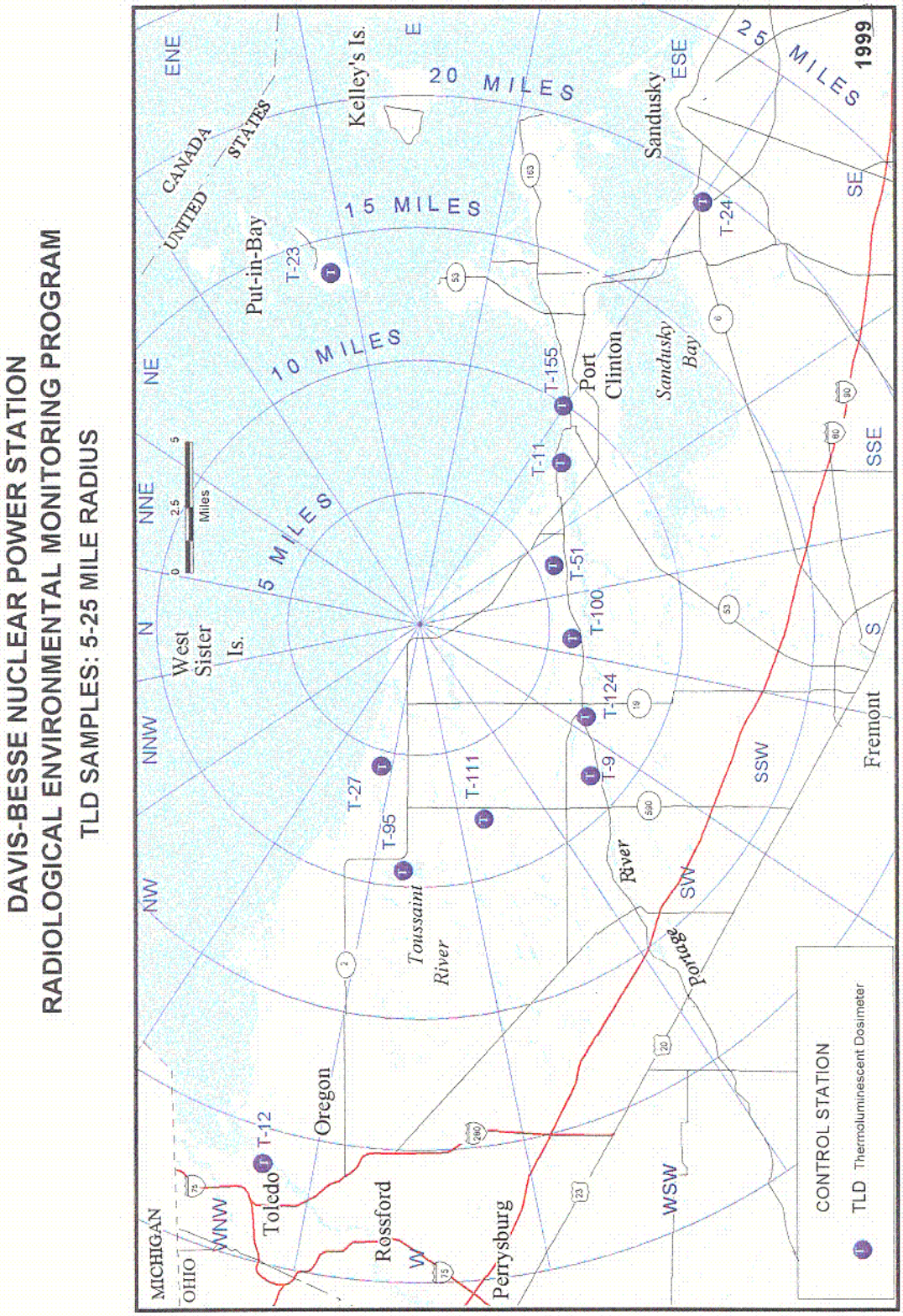

Figure 29: TLD 25-mile Map

L-13

Conclusion

The Radiological Environmental Monitoring Program at Davis-Besse is conducted to determine the radiological impact of the Station's operation on the environment. Radionuclide concentrations measured at indicator locations were compared with concentrations measured at control locations, in previous operational studies and in the preoperational surveillance program. These comparisons indicate normal concentrations of radioactivity in all environmental samples collected in 1999. Davis-Besse's operation in 1999 had no adverse impact on the residents and environment surrounding the station. The results of the sample analyses performed during the period of January through December 1999 are summarized in Appendix D of this report.

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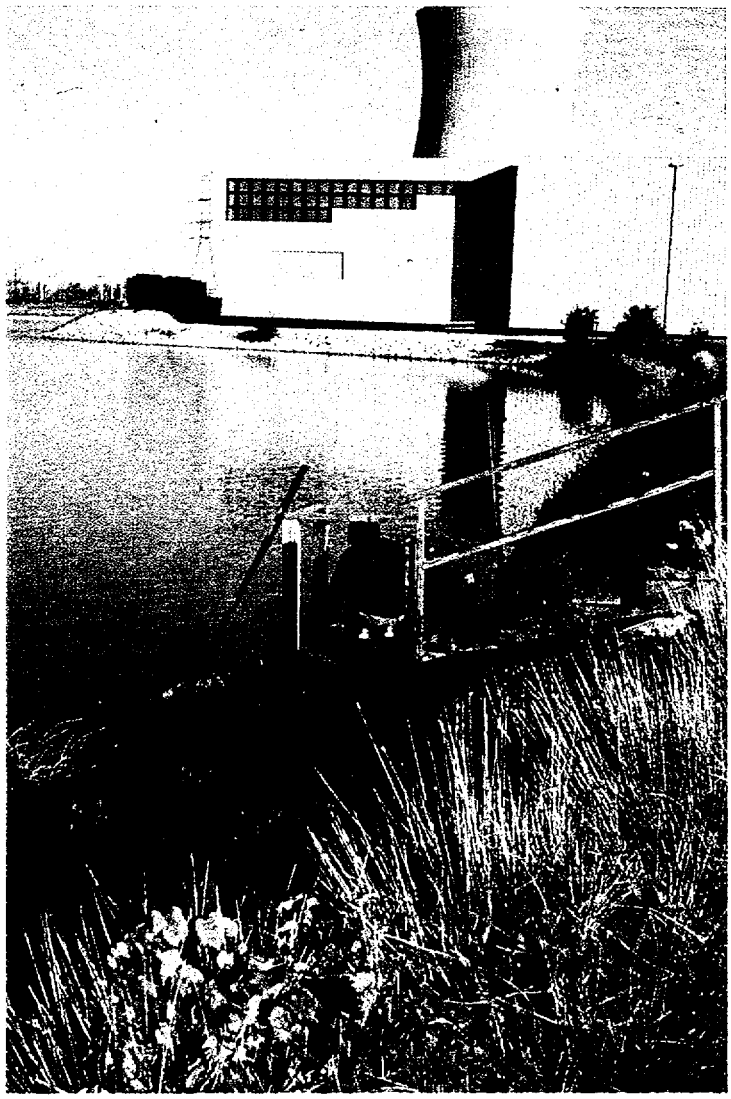


Radioactive Effluent Release Report

Radioactive Effluent Release Report January 1 through December 31, 1999

Protection Standards

Soon after the discovery of x-rays in 1895 by Wilhelm Roentgen, the potential hazards of ionizing radiation were recognized and efforts were made to establish radiation protection standards. The primary source of recommendations for radiation protection standards within the United States is the National Council on Radiation Protection and Measurement (NCRP). Many of these recommendations have been given legislative authority through publication in the Code of Federal Regulations (CFR) by the Nuclear Regulatory Commission (NRC).

The main objective in the control of radiation is to ensure that any dose is kept not only within regulatory limits, but As Low As Reasonably Achievable (ALARA). The ALARA principle applies to reducing radiation dose both to the individual working at Davis-Besse and to the general public. "Reasonably achievable" means that exposure reduction is based on sound economic decisions and operating practices. By practicing ALARA, Davis-Besse minimizes health risk and environmental detriment and ensures that doses are maintained well below regulatory limits.

Sources of Radioactivity Released

During the normal operation of a nuclear power station, most of the fission products are retained within the fuel and fuel cladding. However, small amounts of radioactive fission products and trace amounts of the component and structure surfaces which have been activated are present in the primary coolant water. The three types of radioactive material released are noble gases, iodine and particulates, and tritium.

The noble gas fission products in the primary coolant are given off as a gas when the coolant is depressurized. These gases are then collected by a system designed for gas collection and stored for radioactive decay prior to release.

Small releases of radioactivity in liquids may occur from valves, piping or equipment associated with the primary coolant system. These liquids are collected through a series of floor and equipment drains and sumps. All liquids of this nature are monitored and processed, if necessary, prior to release.

Noble Gas

Some of the fission products released in airborne effluents are radioactive isotopes of noble gases, such as xenon and krypton. Noble gases are biologically and chemically nonreactive.

They do not concentrate in humans or other organisms. They contribute to human radiation dose by being an external source of radiation exposure to the body. Xenon-133 and Xenon-135, with half-lives of approximately five days and nine hours, respectively, are the major radioactive noble gases released. They are readily dispersed in the atmosphere.

Iodine and Particulates

Annual releases of radioisotopes of iodine, and those particulates with half-lives greater than 8 days, in gaseous and liquid effluents are small. Factors such as their high chemical reactivity and solubility in water, combined with the high efficiency of gaseous and liquid processing systems, minimize their discharge. The predominant radioiodine released is iodine-131 with a half-life of approximately eight days. The main contribution of radioactive iodine to human dose is to the thyroid gland, where the body concentrates iodine.

The principal radioactive particulates released are fission products (e.g., cesium-134 and cesium-137) and activation products (e.g., cobalt-58 and cobalt-60). Radioactive cesium and cobalt contribute to internal radiation exposure of tissues such as the muscle, liver, and intestines. These particulates are also a source of external radiation exposure if deposited on the ground.

Tritium

Tritium, a radioactive isotope of hydrogen, is the predominant radionuclide in liquid effluents. It is also present in gaseous effluents. Tritium is produced in the reactor coolant as a result of neutron interaction with deuterium (also a hydrogen isotope) present in the water and with the boron in the primary coolant. When tritium, in the form of water or water vapor, is ingested or inhaled it is dispersed throughout the body until eliminated.

Processing and Monitoring

Effluents are strictly controlled to ensure radioactivity released to the environment is minimal and does not exceed regulatory limits. Effluent control includes the operation of monitoring systems, in-plant and environmental sampling and analyses programs, quality assurance programs for effluent and environmental programs, and procedures covering all aspects of effluent and environmental monitoring.

The radioactive waste treatment systems at Davis-Besse are designed to collect and process the liquid and gaseous wastes which contain radioactivity. For example, the Waste Gas Decay Tanks are holding tanks which allow radioactivity in gases to decay prior to release via the station vent.

Radioactivity monitoring systems are used to ensure that all releases are below regulatory limits. These instruments provide a continuous indication of the radioactivity present. Each instrument is equipped with alarms and indicators in the control room. The alarm setpoints are low enough to ensure the limits will not be exceeded. If a monitor alarms, a release from a tank is automatically stopped.

All wastes are sampled prior to release and analyzed in a laboratory to identify the specific concentrations of radionuclides being released. Sampling and analysis provide a more sensitive and precise method of determining effluent composition than with monitoring instruments alone.

A meteorological tower is located in the southwest sector of the Station. It is linked to computers which record the meteorological data. Coupled with the effluent release data, the meteorological data are used to calculate the dose to the public.

Beyond the plant, devices maintained in conjunction with the Radiological Environmental Monitoring Program constantly sample the air in the surrounding environment. Frequent samples of other environmental media, such as water and vegetation, are also taken to determine if buildup of deposited radioactive material has occurred in the area.

Exposure Pathways

Radiological exposure pathways define the methods by which people may become exposed to radioactive material. The major pathways of concern are those which could cause the highest calculated radiation dose. These projected pathways are determined from the type and amount of radioactive material released, the environmental transport mechanism, and the use of the environment. The environmental transport mechanism includes consideration of physical factors, such as the hydrological (water) and meteorological (weather) characteristics of the area. An annual average on the water flow, wind speed , and wind direction are used to evaluate how the radionuclides will be distributed in an area for gaseous or liquid releases. An important factor in evaluating the exposure pathways is the use of the environment. Many factors are considered such as dietary intake of residents, recreational use of the area, and the locations of homes and farms in the area.

The external and internal exposure pathways considered are shown in Figure 30. The release of radioactive gaseous effluents involves pathways such as external whole body exposure, deposition of radioactive material on plants, deposition on soil, inhalation by animals destined for human consumption, and inhalation by humans. The release of radioactive material in liquid effluents involves pathways such as drinking water, fish consumption, and direct exposure from the lake at the shoreline and while swimming.

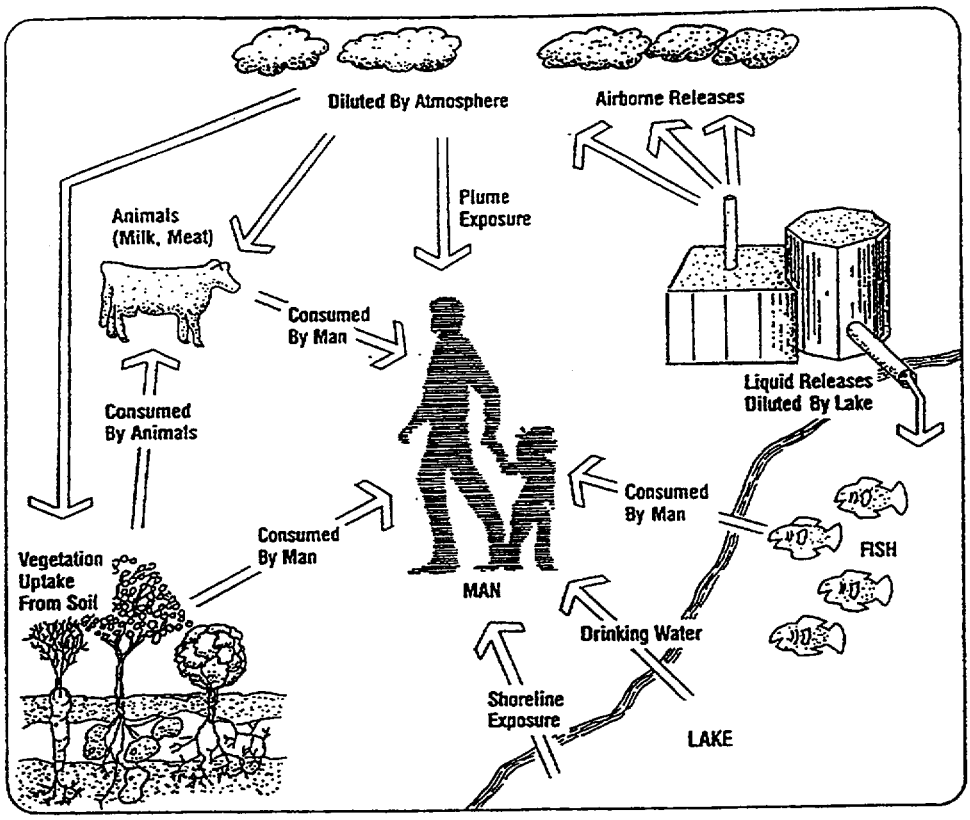


Figure 30: The exposure pathways shown here, are monitored through the Radiological Environmental Monitoring Program (REMP), and are considered when calculating doses to the public.

Although radionuclides can reach humans by many different pathways, some result in more dose than others. The critical pathway is the exposure pathway which will provide, for a specific radionuclide, the greatest dose to a population, or to a specific group of the population, called the critical group. The critical group may vary depending on the radionuclides involved, the age and diet of the group, or other cultural factors. The dose may be delivered to the whole body or to a specific organ. The organ receiving the greatest fraction of the dose is called the critical organ.

Dose Assessment

Dose is the energy deposited by radiation in an exposed individual. Whole body exposure to radiation involves the exposure of all organs. Most background exposures are of this form. Both non-radioactive and radioactive elements can enter the body through inhalation or ingestion. When they do, they are usually not distributed evenly. For example, iodine concentrates in the thyroid gland, cesium collects in muscle and liver tissue, and strontium collects in bone tissue.

The total dose to organs from a given radionuclide depends on the amount of radioactive material present in the organ and the amount of time that the radionuclide remains in the organ. Some radionuclides remain for very short times due to their rapid radioactive decay and/or elimination rate from the body, while other radionuclides may remain in the body for longer periods of time.

The dose to the general public in the area surrounding Davis-Besse is calculated for each liquid or gaseous release. The dose due to radioactive material released in gaseous effluents is calculated using factors such as the amount of radioactive material released, the concentration beyond the site boundary, the average weather conditions at the time of the release, the locations of exposure pathways (cow milk, goat milk, vegetable gardens and residences), and usage factors (inhalation, food consumption). The dose due to radioactive material released in liquid effluents is calculated using factors such as the total volume of liquid, the total volume of dilution water, near field dilution, and usage factors (water and fish consumption, shoreline and swimming factors). These calculations produce a conservative estimation of the dose.

Results

The Radioactive Effluent Release Report is a detailed listing of radioactivity released from the Davis-Besse Nuclear Power Station during the period from January 1, 1999 through December 31, 1999.

- Summation of the quantities of radioactive material released in gaseous and liquid effluents
- Summation of the quantities of radioactive material contained in solid waste packaged and shipped for offsite disposal at federally approved sites
- A listing of all radioactive effluent monitoring instrumentation required by the Offsite Dose Calculation Manual, but which were inoperable for more than 30 days

During this reporting period, the estimated maximum individual offsite dose due to radioactivity released in effluent was:

Liquid Effluents:

- 1.25E-01 mrem, whole body
- 1.35E-01 mrem, thyroid

Gaseous Effluents:

Noble Gas:

- 1.76E-03 mrad, whole body
- 7.10E-03 mrad, skin

Iodine - 131, Tritium, and Particulates with Half-lives greater than 8 Days:

- 1.52E-03 mrem, whole body
- 8.86E-03 mrem, thyroid

These doses are an extremely small fraction of the limits set by the NRC in the Davis-Besse ODCM.

Additional normal release pathways from the secondary system exist. For gaseous effluents, these pathways include the auxiliary feed pump turbine exhausts, the main steam safety valve system and the atmospheric vent valve system, steam packing exhaust and main feed water. For liquid effluents, the additional pathways include the Turbine Building drains via the settling basins. Releases via these pathways are included in the normal release tables in this report.

Regulatory Limits

Gaseous Effluents

In accordance with Offsite Dose Calculation Manual, dose rates due to radioactivity released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:

Noble gases:

- Released at a rate equal to or less than 500 mrem TEDE per year. (Note: the total dose due to these releases is also limited to 50 mrem in any calendar year.)
- Released at a rate such that the total dose to the skin will be less than or equal to 3000 mrem in a year.

Iodine-131, tritium, and all radionuclides in particulate form with half-lives greater than 8 days:

- Released at a rate such that the total dose to any organ will be less than or equal to 1500 mrem in a year.

In accordance with 10CFR50, Appendix I, Sec. IIB. 1, air dose due to radioactivity released in gaseous effluents to areas at and beyond the site boundary shall be limited to the following:

- Less than or equal to 10 mrad total for gamma radiation and less than or equal to 20 mrad total for beta radiation in any calendar year.

In accordance with 10CFR50, Appendix I, Sec. IIC, dose to a member of the public from Iodine-131, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

- Less than or equal to 15 total mrem to any organ in any calendar year.

Liquid Effluents

In accordance with 10CFR50, Appendix I, Sec IIA, the dose or dose commitment to a member of the public from radioactivity in liquid effluents released to unrestricted areas shall be limited to accumulated doses of:

- Less than or equal to 3 mrem to the total body and less than or equal to 10 mrem to any organ in any calendar year.

Effluent Concentration Limits

The Effluent Concentration Limits (ECs) for liquid and gaseous effluents at and beyond the site boundary are listed in 10CFR20, Appendix B, Table II, Column 2, with the most restrictive EC being used in all cases. For dissolved and entrained gases the EC of 2.0E-04 uCi/ml is applied. This EC is based on the Xe-135 DAC of 1E-05 uCi/ml of air (submersion dose) converted to an equivalent concentration in water as discussed in the International Commission on Radiological Protection (ICRP), Publication 2.

Average Energy

The Davis-Besse ODCM limits the dose equivalent rates due to the release of fission and activation products to less than or equal to 500 mrem per year to the total body and less than or equal to 3000 mrem per year to the skin. Therefore, the average beta and gamma energies ($\overline{E}$) for gaseous effluents as described in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants" are not applicable.

Measurements of Total Activity

Fission and Activation Gases:

These gases, excluding tritium, are collected in a marinelli beaker specially modified for gas sampling, steel flasks, or glass vials and are counted on a germanium detector for principal gamma emitters. Radionuclides that are detected are quantified via gamma spectroscopy.

Tritium gas is collected using a bubbler apparatus and counted by liquid scintillation.

Iodine

Iodine is collected on a charcoal cartridge filter and counted on a germanium detector. Specific quantification of each iodine radionuclide is via gamma spectroscopy.

Particulates

Particulates are collected on filter paper and counted on a germanium detector. Specific quantification of each radionuclide present on the filter paper is via gamma spectroscopy.

Liquid Effluents

Liquid effluents are collected in a marinelli beaker and counted on a germanium detector. Quantification of each gamma-emitting radionuclide present in liquid samples is via gamma spectroscopy. Tritium in the liquid effluent is quantified by counting an aliquot of a composite sample in a liquid scintillation counting system.

Batch Releases

Liquid from 1/1/99 through 12/31/99

1. Number of batch releases: 78
2. Total time period for the batch releases: 119.98 hours
3. Maximum time period for a batch release: 160 minutes
4. Minimum time period for a batch release: 64 minutes
5. Average time period for a batch release: 92.29 minutes

Gaseous from 1/1/99 through 12/31/99

1. Number of batch releases: 13
2. Total time period for the batch releases: 160.2 hours
3. Maximum time period for a batch release: 2926 minutes
4. Minimum time period for a batch release: 177 minutes
5. Average time period for batch release: 739.4 minutes

Abnormal Releases

1. Auxiliary Steam 235 pound relief lifted:

	Time(Sec.)	Tritium Release	Exposure Dose
March -	20	1.64E-05 Ci	3.06E-08 mrem
May -	20	9.34E-06 Ci	1.25E-08 mrem
June -	10	6.35E-06 Ci	1.38E-08 mrem

Total activity due to Abnormal Releases is 3.21E-05 Curies of Tritium.
Total Dose due to Abnormal Releases is 5.69E-08 mrem

Percent of ODCM Release Limits

The following table presents the ODCM annual dose limits and the associated offsite dose to the public, in percent of limits, for January 1, 1999 through December 31, 1999.

	SPECIFICATION	ANNUAL DOSE	LIMIT	PERCENT OF LIMIT
Report Period: January 1, 1999- December 31, 1999 (gaseous)				
	Noble gases (gamma)	1.76E-03 mrad	10 mrad	1.76E-02
	Noble gases (beta)	7.10E-03 mrad	20 mrad	3.55E-02
	I-131, tritium and particulates	8.86E-03 mrem	15 mrem	5.91E-02
Report Period: January 1, 1999 - December 31, 1999 (liquid)				
	Total body	1.25E-01 mrem	3 mrem	4.17E+00
	Organ	1.35E-01 mrem	10 mrem	1.35E+00

Sources of Input Data

- Water Usage: Survey of Water Treatment Plants (DSR-95-00347)
- 0-50 mile meat, milk, vegetable production, and population data: 1982 Annual Environmental Operating Report entitled, "Evaluation of Compliance with Appendix I to 10CFR50: Updated Population, Agricultural, Meat - Animal, and Milk Production Data Tables for 1982." This evaluation was based on the 1980 census; the Agricultural Ministry of Ontario 1980 report entitled "Agricultural Statistics and Livestock Marketing Account, 1980"; the Agricultural Ministry of Ontario 1980 report entitled "Agricultural Statistics for Ontario - 1980 Publication 21, 1980"; the Michigan Department of Agriculture, July, 1981 report entitled "Michigan Agricultural Statistics, 1981"; the Ohio Crop Reporting Service, 1981 report entitled, "Ohio Agricultural Statistics, 1981."
- Gaseous and liquid source terms: Tables 17 through 21 of this report.
- Location of the nearest individuals and pathways by sector out to 5 miles, see Land Use Census Section of the report.
- Population of the 50-mile radius of Davis-Besse (DSR-95-00398).

Dose to Public Due to Activities Inside the Site Boundary

In accordance with ODCM Section 7.2, the Radioactive Effluent Release Report includes an assessment of radiation doses from radioactivity released in liquid and gaseous effluents to members of the public due to activities inside the site boundary.

In special instances, members of the public are permitted access to the Radiologically Restricted Area within the Davis-Besse Nuclear Power Station. Tours for the public are conducted with the assurance that no individual will receive any appreciable dose due to radioactivity released in gaseous or liquid effluents (i.e., not more than a small fraction of the 40 CFR190 standards.)

The Wellness Center, Pavilion, Training Center pond, and the forebay/canal areas located inside the DBNPS controlled area are accessible to members of the public. The Wellness Center is an on-site health/exercise facility accessible to the public. The Pavilion is accessible to the public for social activities. The Training Center pond and the forebay/canal area allow a member of the public to fish on site under a "catch-and-release" program; therefore the fish pathway is not considered applicable. Considering the frequency and duration of the visits, the resultant dose would be a small fraction of the calculated maximum site boundary dose. For purposes of assessing the dose to members of the public in accordance with ODCM Section 7.2, the following exposure assumptions are used:

- Exposure time for maximally-exposed visitors is 250 hours (1 hr/day, 5 day/ week, 50 wk/yr)
- Annual average meteorological dispersion (conservative, default use of maximum site boundary dispersion).

- For direct "shine" from the Independent Spent Fuel Storage Installation (ISFSI), default use of the maximum dose rate for a completed (full) ISFSI, and a distance of 950 feet.

The equations in the ODCM may be used for calculating the potential dose to a member of the public for activities inside the site boundary. Based on these assumptions, this dose would be at least a factor of 35 less than the maximum site boundary air dose as calculated in the ODCM. There is no area onsite accessible to the public where exposure to liquid effluents could occur. Therefore, the modeling of the ODCM conservatively estimates the maximum potential dose to members of the public.

Inoperable Radioactive Effluent Monitoring Equipment

The following radioactive effluent monitoring equipment required to be operable by ODCM Section 2.1 and 3.1 was inoperable for more than 30 days during this reporting period.

- Total Dilution Flow, computer point F201, was declared inoperable 2/6/99 due to computer point F886 (Unit Dilution pump flow) not functioning properly. The flow sensors and transmitter FE3611, FT3611, were repaired and tested on 3/19/99 declaring F201 operable. This problem was documented on CR-1999-0199.

- RE1770B was declared inoperable 2/09/99 due to RT1770B failing high during the Channel Calibration and FQI 1700, flow totalizer, not functioning properly on 2/11/99. Upon completion of trouble shooting maintenance activities and new procedure (DB-MI-03401), RE1770B was calibrated, tested and declared operable on 9/21/99. The problem was documented on CR-1999-0315.

Changes to the ODCM and PCP

There was one alteration to the OCDM, Revision 12.0. The PCP had one change, Revision 06, in the reporting period.

Borated Water Storage Tank Radionuclide Concentration

The BWST was out of ODCM specification (Section 2.2.4 – sum of the fractions) from 5/10/99 to 05/17/99 due to a flush containing greater than normal activity following the mid-cycle outage. All additions were suspended to the BWST and the demineralizer placed in service to lower the tank concentration to within the limits.

Table 17
Gaseous Effluents - Summation of All Releases

Type	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999	Est. Total % Error
Fission and Activation Gases						
Total Release	Ci	2.29E+00	1.31E+02	3.29E+00	5.44E+00	2.5E+01
Average Release Rate for Period[a]	µCi/sec	2.90E-01	1.66E+01	4.17E-01	6.90E-01	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limits Section					
Iodines						
Total Iodines	Ci	1.32E-05	6.67E-04	2.09E-05	3.75E-05	2.5E+01
Average Release Rate for Period[a]	µCi/sec	1.67E-06	8.46E-05	2.65E-06	4.76E-06	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limits Section					
Particulates						
Particulates with half-lives greater than 8 days	Ci	LLD	LLD	LLD	3.16E-07	2.5E+01
Average Release Rate for Period[a]	µCi/sec	LLD	LLD	LLD	4.01E-08	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limits Section					
Tritium						
Total Release	Ci	5.56E+00	8.37E+00	5.33E+00	8.89E+00	2.5E+01
Average Release Rate for Period[a]	µCi/sec	7.05E-01	1.06E+00	6.76E-01	1.13E+00	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limits Section					

[a] The average release rate is taken over the entire quarter. It is NOT averaged over the time period of the releases.

Table 18

Gaseous Effluents - Ground Level Releases

Batch Mode[a]

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Fission Gases	Ci				
Kr-85		LLD[b]	LLD[b]	LLD[b]	LLD[b]
Kr-85m		LLD	LLD	LLD	LLD
Kr-87		LLD	LLD	LLD	LLD
Kr-88		LLD	LLD	LLD	LLD
Xe-133		LLD	LLD	LLD	LLD
Xe-135		LLD	LLD	LLD	LLD
Xe-135m		LLD	LLD	LLD	LLD
Xe-138		LLD	LLD	LLD	LLD
Total for Period:		N/A	N/A	N/A	N/A
Iodines	Ci				
I-131		LLD	LLD	LLD	LLD
I-132		LLD	LLD	LLD	LLD
I-133		LLD	LLD	LLD	LLD
I-135		LLD	LLD	LLD	LLD
Total for Period:		N/A	N/A	N/A	N/A
Particulates and Tritium	Ci				
H-3		3.89E-03	4.10E-03	3.48E-03	3.03E-03
Sr-89		LLD	LLD	LLD	LLD
Sr-90		LLD	LLD	LLD	LLD
Cs-134		LLD	LLD	LLD	LLD
Cs-137		LLD	LLD	LLD	LLD
Ba-140		LLD	LLD	LLD	LLD
Co-58		LLD	LLD	LLD	LLD
Total for Period:		3.89E-03	4.10E-03	3.48E-03	3.03E-03

Table 18 (Continued)

Gaseous Effluents - Ground Level Releases

Continuous Mode[c]

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Fission Gases	Ci				
Kr-85		LLD[b]	LLD[b]	LLD[b]	LLD[b]
Kr-85m		LLD	LLD	LLD	LLD
Kr-87		LLD	LLD	LLD	LLD
Kr-88		LLD	LLD	LLD	LLD
Xe-133		LLD	LLD	LLD	LLD
Xe-135		LLD	LLD	LLD	LLD
Xe-135m		LLD	LLD	LLD	LLD
Xe-138		LLD	LLD	LLD	LLD
Total for Period:		N/A	N/A	N/A	N/A
Iodines	Ci				
I-131		LLD	LLD	LLD	LLD
I-133		LLD	LLD	LLD	LLD
I-135		LLD	LLD	LLD	LLD
Total for Period:		N/A	N/A	N/A	N/A
Particulates and Tritium	Ci				
H-3		5.37E-02	2.74E-02	3.38E-02	3.05E-02
Sr-89		LLD	LLD	LLD	LLD
Sr-90		LLD	LLD	LLD	LLD
Cs-134		LLD	LLD	LLD	LLD
Cs-137		LLD	LLD	LLD	LLD
Ba-140		LLD	LLD	LLD	LLD
Total for Period:		5.37E-02	2.74E-02	3.38E-02	3.05E-02

Table 18 (Continued)
Gaseous Effluents - Ground Level Releases
Continuous and Batch Mode

Ar-41:	<2.2E-08	µCi/ml
Kr-85:	<6.2E-06	µCi/ml
Kr-85m:	<2.0E-08	µCi/ml
Kr-87:	<3.4E-08	µCi/ml
Kr-88:	<4.0E-08	µCi/ml
Xe-131m:	<9.0E-08	µCi/ml
Xe-133:	<4.6E-08	µCi/ml
Xe-133m:	<1.6E-07	µCi/ml
Xe-135:	<1.9E-08	µCi/ml
Xe-135m:	<4.0E-07	µCi/ml
Xe-138:	<2.5E-07	µCi/ml
I-131:	<1.0E-07	µCi/ml
I-133:	<2.1E-08	µCi/ml
I-135:	<2.1E-08	µCi/ml
Mn-54	<2.0E-08	µCi/ml
Fe-59:	<4.0E-08	µCi/ml
Co-58:	<3.0E-08	µCi/ml
Co-60:	<2.0E-08	µCi/ml
Zn-65:	<4.0E-08	µCi/ml
Mo-99:	<2.0E-07	µCi/ml
Cs-134:	<2.1E-08	µCi/ml
Cs-137:	<3.0E-08	µCi/ml
Ce-141:	<3.0E-08	µCi/ml
Ce-144:	<1.2E-07	µCi/ml
Ba-140:	<7.0E-08	µCi/ml
La-140:	<3.0E-08	µCi/ml
Sr-89:	<5.0E-08	µCi/ml
Sr-90:	<6.0E-09	µCi/ml

a Auxiliary Feed Pump Turbine Exhaust, Main Steam Safety Valves, and Auxiliary Boiler Outage Release are listed as batch releases.

b These radionuclides were not identified in concentrations above the lower limit of detection (LLD).

c Atmospheric Vent Valve weepage and Steam Packing Exhaust are continuous releases.

Table 19

Gaseous Effluents - Mixed Mode Releases

Batch Mode

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Fission Gases					
Kr-85	Ci	LLD	3.42E+00	1.21E-02	3.17E-01
Kr-85m	Ci	LLD	2.98E-02	LLD	LLD
Kr-87	Ci	LLD	4.33E-04	LLD	LLD
Kr-88	Ci	LLD	2.28E-03	LLD	LLD
Xe-133	Ci	LLD	5.24E+01	3.23E-02	5.45E-01
Xe-133m	Ci	LLD	4.79E-01	LLD	LLD
Xe-135	Ci	LLD	9.44E-01	LLD	LLD
Xe-135m	Ci	LLD	LLD	LLD	LLD
Xe-138	Ci	LLD	LLD	LLD	LLD
Xe-131m	Ci	LLD	9.37E-01	LLD	3.91E-02
Total for Period:		LLD	5.82E+01	4.44E-02	9.01E-01
***Iodines**					
I-131	Ci	LLD	LLD	LLD	LLD
I-132	Ci	LLD	LLD	LLD	LLD
I-133	Ci	LLD	LLD	LLD	LLD
I-135	Ci	LLD	LLD	LLD	LLD
Total for Period:	Ci	LLD	LLD	LLD	LLD
***Particulates**					
H-3	Ci	1.05E-03	4.61E-01	1.21E-03	3.63E-03
Total for Period:	Ci	1.05E-03	4.61E-01	1.21E-03	3.63E-03

* Release of iodines and particulates are quantified in Mixed Mode Releases, Continuous Mode (Unit Station Vent)

Table 19 (Continued)
Gaseous Effluents - Mixed Mode Releases
Continuous Mode

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Fission Gases					
Kr-85	Ci	LLD	LLD	LLD	LLD
Kr-85m	Ci	LLD	LLD	LLD	LLD
Kr-87	Ci	LLD	LLD	LLD	LLD
Kr-88	Ci	LLD	LLD	LLD	LLD
Xe-133	Ci	2.03E+00	7.19E+01	2.87E+00	4.54E+00
Xe-133m	Ci	LLD	LLD	LLD	LLD
Xe-135	Ci	2.59E-01	2.16E-01	3.78E-01	LLD
Xe-135m	Ci	LLD	LLD	LLD	LLD
Xe-138	Ci	LLD	LLD	LLD	LLD
Total for Period:		2.29E+00	7.21+01	3.25E+00	4.54E+00
Iodines					
I-131	Ci	1.26E-05	6.67E-04	2.09E-05	3.75E-05
I-133	Ci	LLD	1.06E-04	5.83E-06	2.20E-05
I-135	Ci	LLD	LLD	LLD	LLD
I-132	Ci	LLD	LLD	LLD	LLD
Total for Period:		1.26E-05	7.73E-04	2.67E-05	5.95E-05
Particulates and Tritium					
H-3	Ci	5.50E+00	7.88E+00	5.29E+00	8.86E+00
Sr-89[b,c]	Ci	LLD	LLD	LLD	LLD
Sr-90[b,c]	Ci	LLD	LLD	LLD	LLD
Cs-134	Ci	LLD	LLD	LLD	LLD
Cs-137	Ci	LLD	LLD	LLD	LLD
Ba-140	Ci	LLD	LLD	LLD	LLD
Co-58	Ci	LLD	LLD	LLD	LLD
La-140	Ci	LLD	LLD	LLD	LLD
Total for Period:		5.50E+00	7.88E+00	5.29E+00	8.86E+00

Table 19 (Continued)

Gaseous Effluents - Mixed Mode Releases

	Continuous Mode[a]		Batch Mode[a]		
Kr-85	<3.3E-06	µCi/ml	Kr-87	<4.5E-06	µCi/ml
Kr-85m	<1.3E-08	µCi/ml	Kr-88	<6.6E-06	µCi/ml
Kr-87	<6.0E-08	µCi/ml	Xe-135	<1.4E-05	µCi/ml
Kr-88	<6.0E-08	µCi/ml	Xe-135m	<2.1E-06	µCi/ml
Xe-131m	<4.4E-07	µCi/ml	Xe-138	<2.8E-05	µCi/ml
Xe-133m	<7.2E-08	µCi/ml	Ar-41	<1.8E-06	µCi/ml
Xe-135	<1.1E-08	µCi/ml	Kr-85	<1.2E-06	µCi/ml
Xe-135m	<5.9E-06	µCi/ml	Xe-133	<2.4E-06	µCi/ml
Xe-138	<2.0E-05	µCi/ml	Xe-133m	<1.0E-05	µCi/ml
I-135[c]	<3.9E-10	µCi/ml			
Mn-54[c]	<2.6E-14	µCi/ml			
Fe-59[c]	<3.0E-14	µCi/ml			
Co-58[c]	<3.0E-14	µCi/ml			
Co-60[c]	<2.5E-14	µCi/ml			
Zn-65[c]	<1.0E-13	µCi/ml			
Mo-99[c]	<1.8E-14	µCi/ml			
Cs-134[c]	<1.6E-14	µCi/ml			
Cs-137[c]	<1.3E-14	µCi/ml			
Ce-141[c]	<1.2E-13	µCi/ml			
Ce-144[c]	<1.2E-14	µCi/ml			
Ba-140[c]	<4.0E-14	µCi/ml			
La-140[c]	<1.0E-14	µCi/ml			
Sr-89[b,c]	<9.3E-16	µCi/ml			
Sr-90[b,c]	<3.1E-16	µCi/ml			

a These radionuclides were not identified in every quarter in concentrations above the lower limit of detection (LLD). The largest LLD value is listed.

b Quarterly composite sample for continuous mode.

c Analysis not required for batch release.

Table 20 Liquid Effluents - Summation of All Releases

Type	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999	Est. Total % Error
Fission and Activation Products						
Total Release (without Tritium, Gases, Alpha)	Ci	1.47E-02	1.47E-02	1.11E-02	4.15E-03	2.0E+01
Average Diluted Concentration During Period[a]	µCi/ml	1.50E-09	1.82E-09	9.65E-10	4.09E-10	
Percent of ODCM Limits	%	See Supplement information in ODCM Release Limits Section				
Percent of 10CFR20 Limit	%	2.54E-02	2.83E-02	1.54E-02	2.13E-03	
Tritium						
Total Release	Ci	2.49E+02	1.57E+02	1.50E+02	1.25E+02	2.0E+01
Average Diluted Concentration During Period[a]	µCi/ml	2.54E-05	1.95E-05	1.30E-05	1.21E-05	
Percent of 10CFR20 Limit	%	2.54E+00	1.95E+00	1.30E+00	1.21E+00	
Dissolved and Entrained Gases						
Total Release	Ci	9.68E-05	1.91E-03	7.25E-06	7.29E-04	2.0E+01
Average Diluted Concentration During Period[a]	µCi/ml	9.86E-12	2.37E-10	6.30E-13	7.08E-11	
Percent of ODCM Limit	%	4.93E-06	1.19E-04	3.15E-07	3.54E-05	
Gross Alpha						
Total Release	Ci	9.24E-06	LLD	LLD	1.07E-05	2.0E+01
Volume of Waste Released (prior to dilution)						
Batch	liter	6.18E+05	5.67E+05	5.50E+05	5.25E+05	2.0E+01
Continuous	liter	1.24E+08	6.53E+07	7.03E+07	6.73E+07	2.0E+01
Volume of Dilution Water						
Batch	liter	1.69E+08	1.62E+08	1.56E+08	1.31E+08	2.0E+01
Continuous	liter	9.53E+09	7.84E+09	1.13E+10	1.01E+10	2.0E+01
Total Volume of Water Released	liter	9.82E+09	8.07E+09	1.15E+10	1.03E+10	

[a] Tritium and alpha are found in both continuous and batch releases. Average diluted concentrations are based on total water volume released during the quarter. Fission and Activation Products and Dissolved and Entrained Gases are normally only detected in batch releases.

Table 21

Liquid Effluents - Nuclides Released

Batch Releases

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Fission and Activation Products					
Co-58	Ci	1.49E-03	3.92E-03	3.88E-03	3.18E-04
Co-60	Ci	4.92E-03	1.71E-03	2.80E-03	1.04E-04
Ag-110m	Ci	3.16E-03	1.41E-03	3.33E-03	3.06E-04
Sb-125	Ci	2.31E-03	3.58E-03	4.82E-04	2.66E-03
Cs-134	Ci	3.39E-06	1.18E-06	LLD	LLD
Cs-137	Ci	9.94E-05	1.83E-05	7.96E-06	7.29E-06
Sr-89[a, b]	Ci	LLD	LLD	LLD	LLD
Sr-90[a, b]	Ci	LLD	LLD	LLD	LLD
Fe-55	Ci	2.35E-03	1.47E-03	LLD	6.83E-04
Cr-51	Ci	LLD	3.66E-04	3.60E-05	3.53E-05
I-131	Ci	2.52E-05	1.06E-03	1.48E-06	1.31E-05
I-132	Ci	LLD	LLD	LLD	LLD
I-133	Ci	LLD	1.06E-05	LLD	LLD
Te-132	Ci	LLD	LLD	LLD	LLD
Tc-99m	Ci	LLD	2.15E-05	LLD	LLD
Sb-124	Ci	LLD	LLD	LLD	5.11E-06
Sn-113	Ci	2.76E-05	4.21E-05	3.68E-05	LLD
Ru-103	Ci	LLD	LLD	1.78E-05	LLD
Mn-54	Ci	3.03E-05	6.07E-05	3.76E-05	LLD
Np-239	Ci	LLD	1.27E-05	LLD	6.85E-06
Co-57	Ci	4.75E-05	3.24E-05	2.02E-05	1.19E-06
Nb-95	Ci	3.12E-05	5.04E-04	LLD	LLD
Zr-95	Ci	4.60E-05	2.84E-04	3.35E-05	LLD
Se-75	Ci	LLD	LLD	LLD	LLD
Fe-59	Ci	LLD	4.40E-05	1.06E-04	LLD
Zn-65	Ci	LLD	LLD	LLD	LLD
Ce-144	Ci	LLD	1.39E-05	9.33E-05	LLD
Na-24	Ci	LLD	LLD	LLD	LLD
Zr-97	Ci	1.67E-04	6.94E-05	1.70E-04	1.07E-05
Ce-141	Ci	LLD	LLD	2.74E-05	LLD
Nb-97	Ci	LLD	5.19E-06	LLD	LLD
La-140	Ci	LLD	1.92E-05	LLD	LLD
Ba-140	Ci	LLD	1.71E-05	LLD	LLD
Ru-106	Ci	LLD	2.53E-05	LLD	LLD
Ba-139	Ci	LLD	5.88E-06	LLD	LLD
Total for Period:	Ci	1.47E-02	1.47E-02	1.11E-02	4.15E-03

Table 21 (continued)

Liquid Effluents - Nuclides Released

Batch Releases

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Tritium	Ci	2.49E+02	1.57E+02	1.50E+02	1.25E+2
Dissolved and Entrained Gases					
Kr-85m	Ci	LLD[a]	LLD[a]	LLD[a]	LLD[a]
Kr-85	Ci	LLD	LLD	LLD	LLD
Xe-131m	Ci	LLD	1.31E-04	LLD	LLD
Xe-133	Ci	9.68E-05	1.76E-03	7.25E-06	7.29E-04
Xe-135	Ci	LLD	1.87E-06	LLD	8.16E-07
Xe-133m	Ci	LLD	1.96E-05	LLD	LLD
Total for Period:	Ci	9.68E-05	1.91E-03	7.25E-06	7.29E-04

Table 21 (continued)

Liquid Effluents - Nuclides Released

Continuous Releases

Nuclide	Unit	1st Qtr 1999	2nd Qtr 1999	3rd Qtr 1999	4th Qtr 1999
Fission and Activation Products					
Cr-51	Ci	LLD[a]	LLD[a]	LLD[a]	LLD[a]
Fe-59	Ci	LLD	LLD	LLD	LLD
Co-58	Ci	LLD	LLD	LLD	LLD
Co-60	Ci	LLD	LLD	LLD	LLD
Zn-65	Ci	LLD	LLD	LLD	LLD
Sr-89[a,b]	Ci	LLD	LLD	LLD	LLD
Sr-90[a,b]	Ci	LLD	LLD	LLD	LLD
Nb-95	Ci	LLD	LLD	LLD	LLD
Zr-95	Ci	LLD	LLD	LLD	LLD
Mo-99	Ci	LLD	LLD	LLD	LLD
Tc-99m	Ci	LLD	LLD	LLD	LLD
I-131	Ci	LLD	LLD	LLD	LLD
Cs-134	Ci	LLD	LLD	LLD	LLD
Cs-137	Ci	LLD	LLD	LLD	LLD
Ba-140/La-140	Ci	LLD	LLD	LLD	LLD
Ce-141	Ci	LLD	LLD	LLD	LLD
Total for Period:		N/A	N/A	N/A	N/A
Tritium	Ci	3.90E-01	2.97E-01	3.00E-01	4.43E-01
Dissolved and Entrained Gases					
Kr-85	Ci	LLD	LLD	LLD	LLD
Xe-131m	Ci	LLD	LLD	LLD	LLD
Xe-133	Ci	LLD	LLD	LLD	LLD
Xe-133m	Ci	LLD	LLD	LLD	LLD
Xe-135	Ci	LLD	LLD	LLD	LLD
Total for Period:	Ci	N/A	N/A	N/A	N/A

Table 21 (continued)

Liquid Effluents - Nuclides Released[a]

Na-24	<2.0E-08	µCi/ml	Sb-124	<1.0E-08	µCi/ml
Cr-51	<1.7E-07	µCi/ml	Sb-125	<1.7E-08	µCi/ml
Mn-54	<2.1E-08	µCi/ml	Te-132	<1.8E-08	µCi/ml
Fe-55[b]	<7.0E-07	µCi/ml	Ce-141	<3.0E-08	µCi/ml
Fe-59	<4.2E-08	µCi/ml	Ce-144	<1.7E-07	µCi/ml
Co-57	<1.6E-08	µCi/ml	Cs-134	<2.1E-08	µCi/ml
Co-58	<1.9E-08	µCi/ml	Ce-136	<2.8E-08	µCi/ml
Co-60	<2.5E-08	µCi/ml	Cs-137	<2.7E-08	µCi/ml
Zn-65	<5.2E-08	µCi/ml	Ba-140	<7.0E-08	µCi/ml
Se-75	<2.4E-08	µCi/ml	La-140	<3.0E-08	µCi/ml
Sr-89[b]	<3.0E-08	µCi/ml	Np-239	<1.2E-07	µCi/ml
Sr-90[b]	<8.0E-09	µCi/ml	I-131	<2.5E-08	µCi/ml
Zr-95	<4.0E-08	µCi/ml	I-132	<1.0E-08	µCi/ml
Zr-97	<2.5E-08	µCi/ml	I-133	<2.1E-08	µCi/ml
Nb-95	<2.1E-08	µCi/ml	I-135	<1.7E-07	µCi/ml
Mo-99	<1.6E-07	µCi/ml	Kr-85	<6.2E-06	µCi/ml
Tc-99m	<1.8E-08	µCi/ml	Xe-131	<7.7E-07	µCi/ml
Ru-103	<2.2E-08	µCi/ml	Xe-133	<4.6E-08	µCi/ml
Ag-110m	<2.5E-08	µCi/ml	Xe-133m	<1.6E-07	µCi/ml
Sn-113	<2.8E-08	µCi/ml	Xe-135	<1.9E-08	µCi/ml

[a] These radionuclides were not identified every quarter in concentrations above the lower limit of detection (LLD). The largest LLD value is used for each radionuclide. LLDs are applicable to both batch and continuous modes due to identical sample and analysis methods.

[b] Quarterly composite sample

Table 22

Solid Waste and Irradiated Fuel Shipments

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not irradiated fuel)

1. Type of Waste		Unit	12-month Period	Est. Total Error, %
a.	Spent resins, filter sludges, evaporator bottoms, etc.	m^3 Ci	1.95E+01 2.39E-01	2.5E+01 2.5E+01
b.	Dry compressible waste, contaminated equip., etc.	m^3 Ci	8.41E+00 3.18E-01	2.5E+01 2.5E+01
c.	Irradiated components, control rods, etc.	m^3 Ci	 N/A	 N/A
d.	Others: dewatered primary system cartridge filters	m^3 Ci	3.08E-01 4.69E-02	2.5E+01 2.5E+01

2. Estimate of major nuclide composition (by type of waste)

	Type	Percent (%)	Est. Total Error, %
a. Spent Resins	Fe^{55}	3.19E+01	2.50E+01
	Co^{58}	2.00E+01	2.50E+01
	Co^{60}	8.41E+00	2.50E+01
	Ni^{63}	2.13E+01	2.50E+01
	Sb^{125}	4.52E+00	2.50E+01
	Cs^{134}	1.19E+00	2.50E+01
	Cs^{137}	4.06E+00	2.50E+01
	C^{14}	4.52E+00	2.50E+01
b. Dry compressible waste, contaminated equipment, etc.	Fe^{55}	6.69E+01	2.50E+01
	Co^{60}	1.34E+00	2.50E+01
	C^{14}	2.05E+00	2.50E+01
	Cs^{134}	2.53E+00	2.50E+01
	Cs^{137}	2.22E+01	2.50E+01
	Co^{58}	3.70E+00	2.50E+01
c. None			
d. Cartridge filters	Fe^{55}	9.89E+00	2.50E+01
	Co^{58}	4.61E+01	2.50E+01
	Ni^{63}	2.28E+01	2.50E+01
	Zr^{95}	1.05E+00	2.50E+01
	Cs^{137}	3.07E+00	2.50E+01
	Co^{60}	8.70E+00	2.50E+01
	C^{14}	3.78E+00	2.50E+01
	Nb^{95}	1.10E+00	2.50E+01

Table 22 (continued)

Solid Waste and Irradiated Fuel Shipments

3. Solid Waste Disposition

Number of Shipments:	1
Mode of Transportation:	Truck
Destination:	Barnwell, SC
Type of Container (Container Volume):	1 resin/filter media HIC (5.72 m^3) buried
Number of Shipments:	3
Mode of Transportation:	Truck
Destination:	GTS Duratek, Oak Ridge, TN for processing then disposal at Envirocare of Utah or Barnwell S.C.
Type of Container (Container Volume):	Metal boxes
Volume shipped for processing	133.79m^3
Volume disposed	2.56m^3
Number of Shipments:	1
Mode of Transportation:	Truck
Destination:	ATG Inc. Richland Washington for processing then disposal at Envirocare of Utah
Type of Container (Container Volume):	Steel liner
Volume shipped for processing	13.8m^3
Volume disposed	13.8m^3
Number of Shipments:	1
Mode of Transportation:	Truck
Destination:	Frank W. Hake, Inc. Memphis Tenn. for processing then disposal at Envirocare of Utah
Type of Container (Container Volume):	Metal boxes
Volume shipped for processing	35.68m^3
Volume disposed	5.85m^3

B. IRRADIATED FUEL SHIPMENTS

There were no shipments of irradiated fuel.

Table 23

Doses Due to Gaseous Releases

For January through December 1999

Maximum Individual Dose Due to I-131, H-3 and Particulates with Half-Lives Greater than 8 days.

Whole Body Dose	1.52E-03 mrem
Significant Organ Dose	8.86E-03 mrem

Maximum Individual Dose Due to Noble Gas

Whole Body Dose	1.76E-03 mrad
Skin Dose	7.10E-03 mrad

Population Dose Due to I-131, H-3 and Particulates with Half-Lives Greater than 8 days.

Total Integrated Population Dose	1.14E-02 person-rem
Average Dose to Individual in Population	5.23E-06 mrem

Population Dose Due to Noble Gas

Total Integrated Population Dose	3.71E-03 person-rem
Average Dose to Individual in Population	1.70E-06 mrem

Table 24
Doses Due to Liquid Releases
for January through December 1999

Maximum Individual Whole Body Dose	1.25E-01	mrem
Maximum Individual Significant Organ Dose	1.35E-01	mrem
Population Dose		
Total Integrated Population Dose	1.23E+00	person-rem
Average Dose to Individual	5.64E-04	mrem

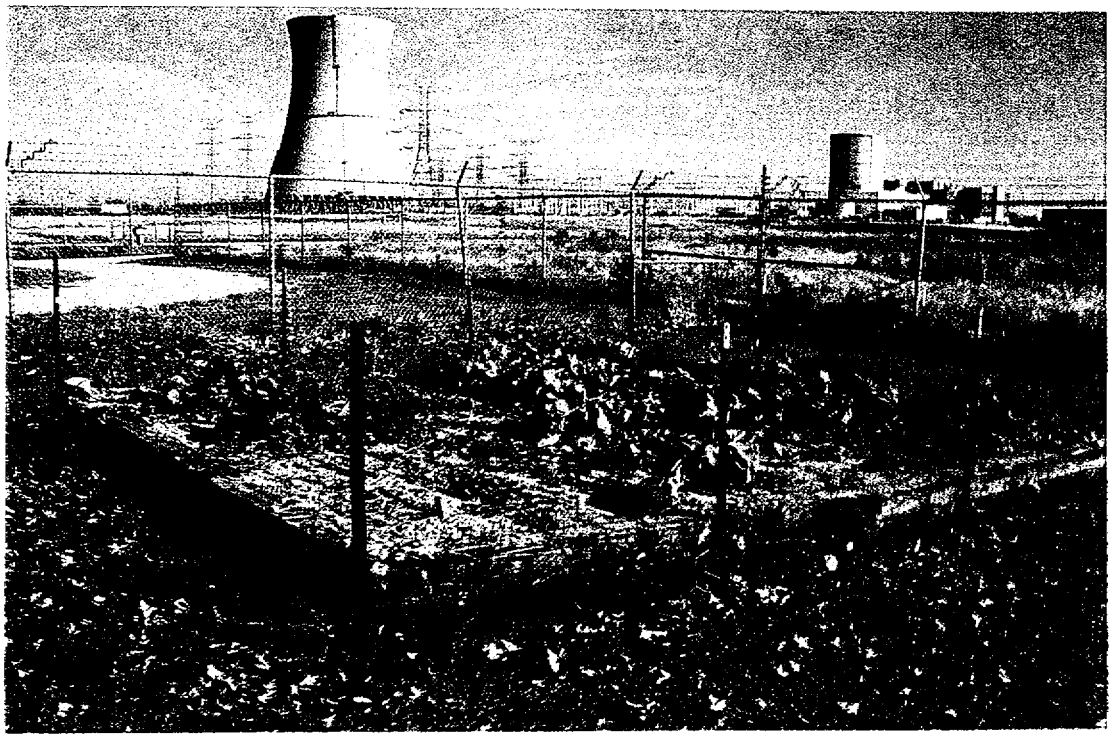
Table 25

Annual Dose to The Most Exposed Member of The Public 1999

	ANNUAL DOSE (mrem)	40CFR190 LIMIT (mrem)	PERCENT OF LIMIT
Whole Body Dose			
Noble Gas	1.76E-03		
Iodine, Tritium, Particulates	1.52E-03		
Liquid	1.25E-01		
Total Whole Body Dose	1.28E-01	25	5.13E-01
Thyroid Dose			
Iodine, Tritium, Particulates	8.86E-03	75	1.18E-02
Skin Dose			
Noble Gas	7.10E-04	25	2.84E-03
Significant Organ Dose (Thyroid)	1.35E-01	25	5.40E-01

Meteorological Data

Meteorological data on 3½ inch microdisk for January through December 31, 1999, has been submitted with this document to the U. S. Nuclear Regulatory Commission, Document Control Desk, Washington, D.C. 20555.



Land Use Census

Land Use Census

Program Design

Each year a Land Use Census is conducted by Davis-Besse in order to update information necessary to estimate radiation dose to the general public and to determine if any modifications are necessary to the Radiological Environmental Monitoring Program (REMP). The Land Use Census is required by Title 10 of the Code of Federal Regulations, Part 50, Appendix I and Davis-Besse Nuclear Power Station Offsite Dose Calculation Manual, Section 5, Assessment of Land Use Census Data. The Land Use Census identifies gaseous pathways by which radioactive material may reach the general population around Davis-Besse. The information gathered during the Land Use Census for dose assessment and input into the REMP ensure these programs are as current as possible. The pathways of concern are listed below:

- **Inhalation Pathway** - Internal exposure as a result of breathing radionuclides carried in the air.
- **Ground Exposure Pathway** - External exposure from radionuclides deposited on the ground
- **Plume Exposure Pathway** - External exposure directly from a plume or cloud of radioactive material.
- **Vegetation Pathway** - Internal exposure as a result of eating vegetables, fruit, etc. which have a build up of deposited radioactive material or which have absorbed radionuclides through the soil.
- **Milk Pathway** - Internal exposure as a result of drinking milk which may contain radioactive material as a result of a cow or goat grazing on a pasture contaminated by radionuclides.

Methodology

The Land Use Census consists of recording and mapping the locations of the closest residences, dairy cattle and goats, and broad leaf vegetable gardens (greater than 500 square feet) in each meteorological sector within a five mile radius of Davis-Besse.

The surveillance portion of the 1999 Land Use Census was performed during the month of July. In order to gather as much information as possible, the locations of residences, dairy cows, dairy goats, and vegetable gardens were recorded. The residences, vegetable gardens, and milk animals are used in the dose assessment program. The vegetable gardens must be at least 500 square feet in size, with at least 20% of the vegetables being green leafy plants (such as lettuce, cabbage, and kale).

Each residence is tabulated as being an inhalation pathway, as well as ground and plume exposure pathways. Each garden is tabulated as a vegetation pathway.

All of the locations identified are plotted on a map (based on the U.S. Geological Survey 7.5 minute series of the relevant quadrangles) which has been divided into 16 equal sectors corresponding to the 16 cardinal compass points (Figure 31). The closest residence, milk animal, and vegetable garden in each sector are determined by measuring the distance from each to the station vent at Davis-Besse.

Results

The following changes in the pathways were recorded in the 1999 census:

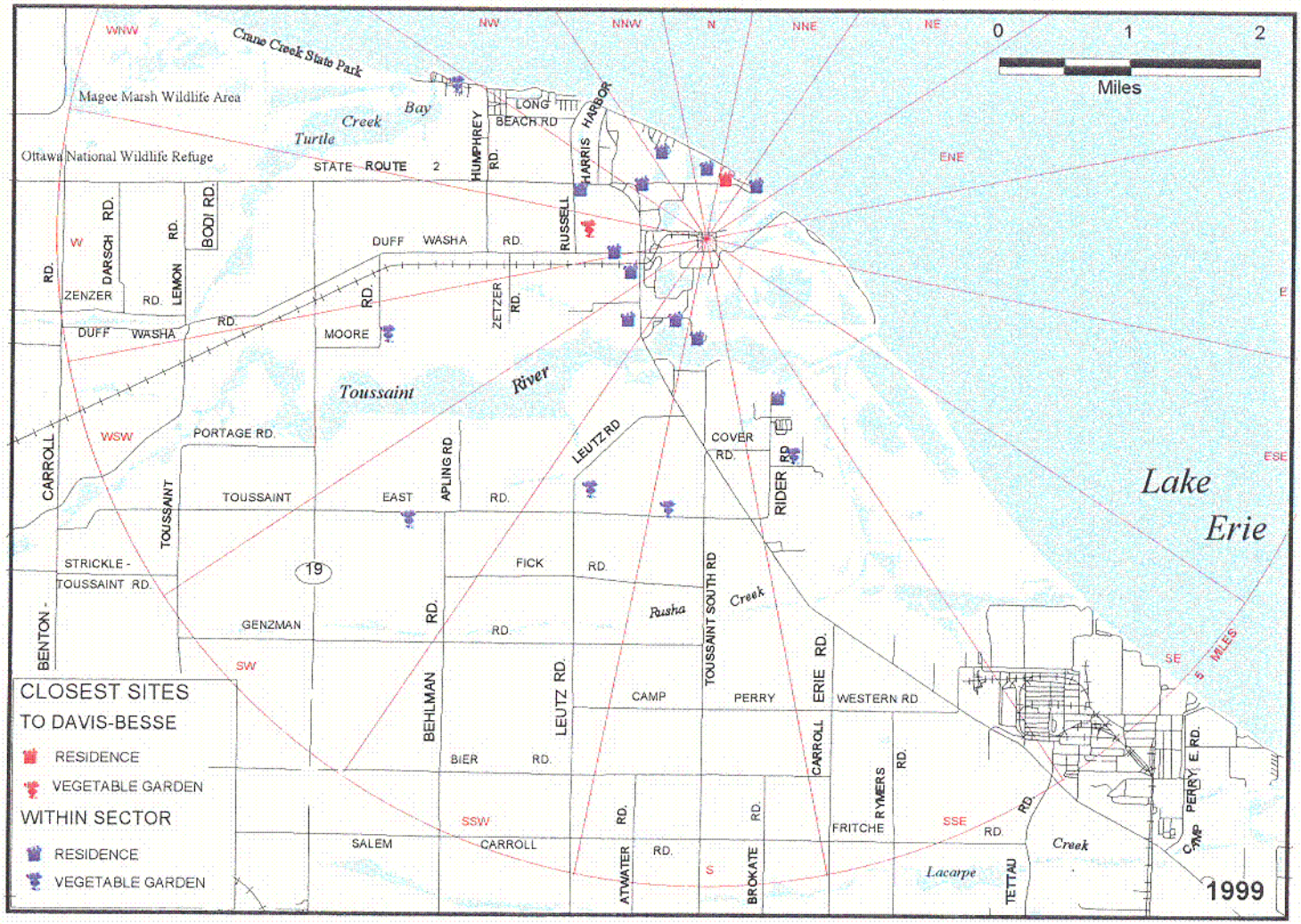
- **SSW Sector –** The garden at 3450 meters was replaced by a garden at 2350 meters
- **SW Sector -** The garden at 4920 meters was replaced by a garden at 5330 meters.
- **WNW Sector** – The garden at 3650 meters was replaced with a garden at 2900 meters.
- **NW** – A garden was added at 2300 meters.

The critical receptor identified by the 1999 Land Use Census is a garden in the **W** sector at 1540 meters from Davis-Besse.

The detailed list in Table 26 was used to update the database of the effluent dispersion model used in dose calculations. Table 26 is divided by sectors and lists the distance (in meters) of the closest pathway in each meteorological sector.

Table 27 provided information on pathways, critical age group, atmospheric dispersion (X/Q) and deposition (D/Q) parameters for each sector. This information is used to update the Offsite Dose Calculation Manual (ODCM). The ODCM describes the methodology and parameters used in calculating offsite doses from radioactivity released in liquid and gaseous effluents and in calculating liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints.

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
PRIMARY PATHWAYS WITHIN 5 MILES RADIUS



ENVIRONMENTAL MONITORING

Figure 31: Land Use Census Map

C-14

Table 26
Closest Exposure Pathways Present in 1999

Sector	Distance from Station (meters)	Closest Pathways
N	860	Inhalation Ground Exposure Plume Exposure
NNE	860	Inhalation Ground Exposure Plume Exposure
NE	890	Inhalation Ground Exposure Plume Exposure
ENE, E, ESE, SE	N/A	Located over Lake Erie
SSE	2810	Vegetation
SSE	2040	Inhalation Ground Exposure Plume Exposure
S	3360	Vegetation
S	1060	Inhalation Ground Exposure Plume Exposure
SSW**	2350	Vegetation
SSW	1010	Inhalation Ground Exposure Plume Exposure
SW**	5330	Vegetation
SW	1180	Inhalation Ground Exposure Plume Exposure

** Changes since 1998

Table 26 (continued)
Closest Exposure Pathways Present in 1999

Sector	Distance from Station (meters)	Closest Pathways
WSW	1700	Inhalation Ground Exposure Plume Exposure
W	980	Inhalation Ground Exposure Plume Exposure
W	1540	Vegetation
WNW	1730	Inhalation Ground Plume Exposure
WNW**	2900	Vegetation
NW	1750	Inhalation Ground Exposure Plume Exposure
NW**	2300	Vegetation
NNW	1270	Inhalation Ground Exposure Plume Exposure

** Changes since 1998

Table 27
Pathway Locations and Corresponding Atmospheric Dispersion (X/Q) and Deposition (D/Q) Parameters

SECTOR	METERS	CRITICAL PATHWAY	AGE GROUP	X/Q (SEC/M^3)	D/Q (M^{-2})
N	860	Inhalation	Child	9.54E-07	8.70E-09
NNE	860	Inhalation	Child	1.29E-06	1.49E-08
NE	890	Inhalation	Child	1.29E-06	1.61E-08
ENE*	---	---	---	---	---
E*	---	---	---	---	---
ESE*	---	---	---	---	---
SE*	---	---	---	---	---
SSE	2810	Vegetation	Child	7.04E-08	8.42E-10
S	3360	Vegetation	Child	4.47E-08	4.76E-10
SSW**	2350	Vegetation	Child	5.90E-08	1.03E-09
SW**	5330	Vegetation	Child	3.76E-08	3.21E-10
WSW	1700	Inhalation	Child	1.76 E-07	3.11E-09
W	1540	Vegetation	Child	3.01E-07	4.80E-09
WNW**	2900	Vegetation	Child	7.19E-08	6.50E-10
NW**	2300	Vegetation	Child	6.98 E-08	5.79E-09
NNW	1270	Inhalation	Child	2.40E-07	1.73E-09

* Since these sectors are located over marsh areas and Lake Erie, no ingestion pathways are present.

** Changes since 1998

Non-Radiological Environmental Programs

Non-Radiological Environmental Programs

Meteorological Monitoring

The Meteorological Monitoring Program at Davis-Besse is required by the Nuclear Regulatory Commission (NRC) as part of the program for evaluating the effects of routine operation of nuclear power stations on the surrounding environment. Both NRC regulations and the Davis-Besse Technical Requirements Manual provide guidelines for the Meteorological Monitoring Program. These guidelines ensure that Davis-Besse has the proper equipment, in good working order, to support the many programs utilizing meteorological data.

Meteorological observations at Davis-Besse began in October 1968. The Meteorological Monitoring Program at Davis-Besse has an extensive record of data with which to perform climatological studies which are used to determine whether Davis-Besse has had any impact upon the local climate. After extensive statistical comparative research the meteorological personnel have found no impact upon local climate or short term weather patterns.

The Meteorological Monitoring Program also provides data that can be used by many other groups and programs: Radiological Environmental Monitoring Program, The Emergency Preparedness Program, The Chemistry Unit, and groups such as Plant Operations, Plant Security, Materials Management, Industrial Safety Program, plant personnel and members of the surrounding community.

The Radiological Environmental Monitoring Program uses meteorological data to aid in evaluating the radiological impact, if any, of radioactivity released in Station effluents. The meteorological data is used to evaluate radiological environmental monitoring sites to assure the program is as current as possible. The Emergency Preparedness Program uses meteorological data to calculate emergency dose scenarios for emergency drills and exercises and uses weather data to plan evacuations or station isolation during adverse weather. The Chemistry Unit uses meteorological data for chemical spill response activities, marsh management studies, and wastewater outfall flow calculations. Plant Operations uses meteorological data for cooling tower efficiency calculations, forebay water level availability and plant work which needs certain environmental conditions to be met before work begins. Plant Security utilizes weather data in their routine planning and activities. Materials Management plans certain plant shipments around adverse weather conditions to avoid high winds and precipitation which would cause delays in material deliveries and safety concerns. Industrial Safety uses weather and climatological data to advise personnel of unsafe working conditions due to environmental conditions, providing a safer place to work. Legal Affairs uses climatological data for their investigation into adverse weather accidents to the plant and personnel.

On-site Meteorological Monitoring

System Description

At Davis-Besse there are two meteorological systems, a primary and a backup. They are both housed in separate environmentally controlled buildings with independent power supplies. Both primary and backup systems have been analyzed to be "statistically identical" to the other so if one system fails the other can take its place. The instrumentation of each system follows:

PRIMARY	BACKUP
100 Meter Wind Speed	100 Meter Wind Speed
75 Meter Wind Speed	75 Meter Wind Speed
10 Meter Wind Speed	10 Meter Wind Speed
100 Meter Wind Direction	100 Meter Wind Direction
75 Meter Wind Direction	75 Meter Wind Direction
10 Meter Wind Direction	10 Meter Wind Direction
100 Meter Delta Temperature	100 Meter Delta Temperature
75 Meter Delta Temperature	75 Meter Delta Temperature
10 Meter Ambient Temperature	10 Meter Ambient Temperature
10 Meter Dew Point	10 Meter Solar Insolation
Precipitation	

Meteorological Instrumentation

The meteorological system consists of one monitoring site located at an elevation of 577 feet above mean sea level (IGLD 1955)*, a 100m free-standing tower located about 3,000 feet SSW of the cooling tower, and an auxiliary 10m foot tower located 100 feet west of the 100 m tower, are used to gather the meteorological data. The 100m tower has primary and backup instruments for wind speed and wind direction at 100m and 75m. The 100m tower also measures differential temperature (delta Ts): 100-10m and 75-10m. The 10m tower has instruments for wind speed and wind direction. Precipitation is measured by a tipping bucket rain gauge located near the base of the 10m tower.

According to the Davis-Besse Nuclear Power Station Technical Requirements Manual, a minimum of five instruments are required to be operable at the two lower levels (75m and 10m) to measure temperature, wind speed, and wind direction. During 1999, annual data recoveries for all required instruments were 99.6 percent. Minor losses of data occurred during routine instrument maintenance, calibration, and data validation.

Personnel at Davis-Besse inspect the meteorological site and instrumentation regularly. Data is reviewed daily to ensure that all communication pathways, data availability and data reliability are working as required. Tower instrumentation maintenance and semiannual calibrations are performed by in-house facilities and an outside consulting firm. These instruments are wind tunnel tested to assure compliance with applicable regulations and plant specifications.

* International Great Lakes Data - 1955

Meteorological Data Handling and Reduction

Each meteorological system, primary and backup, have two Campbell Scientific Dataloggers (model 21XL) assigned to them. The primary system has a first datalogger to communicate 900 second averages to the control room via a Digital Alpha computer system. This is a dedicated line. If a failure occurs at any point between the primary meteorological system and the control room the control room can utilize the second data logger in the primary shelter. Each datalogger has its own dedicated communication link with battery backup. The backup meteorological system is designed the same as the primary; so to lose all meteorological data the primary and backup meteorological systems would have to lose all four dataloggers. However, this would be difficult since each is powered by a different power supply and equipped with lightning and surge protection, plus four independent communication lines and datalogger battery backup.

The data from the primary and backup meteorological systems are stored in a 30-day circular storage module with permanent storage held by the Digital Alpha computer. Data goes back to 1988 in this format and to 1968 in both digital and hardcopy formats. All data points are scrutinized every 900 seconds by meteorological statistics programs running continuously. These are then reviewed by meteorological personnel daily for validity based on actual weather conditions. A monthly review is performed using 21 NRC computer codes which statistically analyze all data points for their availability and validity. If questionable data on the primary system can not be corroborated by the backup system, the data in question is eliminated and not incorporated into the final data base. All validated data is then documented and stored on hard copy and in digital format for a permanent record of meteorological conditions.

Joint Frequency Distributions and Wind Sector Graphics

Summary statistics and Joint Frequency Distributions (JFDs) of wind and stability data are generated and the results are reviewed for consistency in terms of known site characteristic and regional climate. The end result of the review process is a validated final database suitable for use by atmospheric dispersion models and for site meteorological characterizations. Wind Sector Graphics represent the frequency of wind direction by sector and the wind speed in MPH by sector. This data is used by the NRC to better understand local wind patterns as they relate to defined past climatological wind patterns as reported in Davis-Besse's "Updated Safety Analysis Report."

Meteorological Data Summaries

This section presents summaries of the meteorological data collected from the on-site monitoring program at Davis-Besse during 1999. Tables 28 through 30, discussed in this section, can be found on pages 120 through 139.

Wind Speed and Wind Direction

The maximum measured sustained wind speeds for 1999 were 45.36 mph for the 100m level on January 2, 45.42 mph for the 75m level on April 6, and 35.02 mph for the 10m level on April 6. Figures 32-34 give an annual sector graphic of average wind speed and percent frequency by direction measured at the three monitoring levels. Each wind sector graphic has two radial bars,

the darker bar represents the percent of time the wind blew from that direction. The hatched bar represents the average speed of the wind from that direction. Wind direction sectors are classified using Pasquill Stabilities. Calms (less than or equal to 1.0 mph) are shown in percent in the middle of the wind sector graphic.

Ambient and Differential Temperatures

Monthly average, minimum and maximum ambient temperatures for 1999 are given in Table 29. These data are measured at the 10m level; with differential temperatures taken from 100m and 75m levels. The yearly average ambient temperature for 1999 was 51.86°F. The maximum temperature was 93.85°F on July 4 with the minimum temperature of –4.84°F on January 5. Yearly average differential temperatures were -0.15°F (100m), and -0.09°F (75m). Maximum differential temperatures for 100m and 75m levels were 7.99°F on November 21 (100m), and 6.03°F on April 21 (75m). Minimum differential temperatures for 100m and 75m levels were -3.99°F on October 18 (100m) and –4.48°F on August 18 (75m). Differential temperatures are a measurement of atmospheric stability and used to calculate radioactive plume dispersions based on the Gaussian Plume Models of continuous effluent releases.

Dew Point Temperatures and Relative Humidity

Monthly average and extreme dew point and humidity temperatures for 1999 are provided in Table 29. These data are measured at the 10 meter level. The average dew point temperature was 42.81°F with a maximum dew point temperature of 76.40°F on July 30. Please note that dew point temperatures above 75°F are highly suspect and are possibly due to calm winds and high solar heating allowing the aspirated dew point processor to retain heat. The minimum dew point (dew point under 32°F is frost point) temperature was –5.66°F on January 5. Average relative humidity is 73.42 percent for the year. The maximum relative humidity was 100.00 percent on December 31. The minimum relative humidity was 22.84 percent on March 29. It is possible to have relative humidity above 100 percent which is known as super saturation. Conditions for super saturation have been met a few times at Davis-Besse due to its close proximity to Lake Erie and the evaporative pool of moisture available by such a large body of water.

Precipitation

Monthly totals and extremes of precipitation at Davis-Besse for 1999 are given in Table 29. Total precipitation for the year was 27.70 inches. The maximum daily precipitation total was 1.83 inches in August. The minimum was 0.37 inches recorded in March. It is likely that precipitation totals recorded in colder months are somewhat less than actual due to snow/sleet blowing across the collection unit rather than accumulating in the gauge.

Lake Breeze and Lake Level Monitoring

Lake Breeze is monitored at Davis-Besse because of its potential to cause major atmospheric/ dispersion problems during an unlikely radioactive release. A lake breeze event occurs during the daytime, usually during the summer, where the land surface heats up faster than the water, and therefore reaches higher temperatures than the water. The warmer air above the land rises faster because it is less dense than the cooler air over the lake. This leads to rising air currents over the land with descending denser air over the lake. This starts a wind circulation, which

draws air from the water to the land during the daytime, creating a "Lake Breeze" effect. This event could be problematic if a release were to occur because diffusion would be slow thus creating an adverse atmosphere to the surrounding site.

Lake and forebay levels are monitored at Davis-Besse to observe, evaluate, predict and disseminate high or low lake level information. This data is critical in the running of the plant due to the large amounts of water needed to cool plant components. If water levels get too low the plant operators can take measures for the safe shut down of the plant. Since Lake Erie is the shallowest lake in the Great Lakes, it is not uncommon for a plus or minus five foot lake level fluctuation to occur within an eight to ten hour period. High water levels also effect the plant due to emergency transportation and evacuation pathways.

Table 28
Summary of Meteorological Data Recovery for 1999

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1999
100m Wind Speed	100	100	53.63	55.83	100	100	100	100	100	99.87	100.00	99.87	92.42
100M Wind Direction	100	100	99.33	99.86	100	100	100	100	100	99.87	100.00	99.87	99.91
75M Wind speed	100	99.85	99.33	99.86	100	100	100	100	100	99.87	100.00	99.87	99.89
75M Wind Direction	100	100	99.33	99.86	100	100	100	100	100	99.87	100.00	99.87	99.91
10M Wind Speed	99.06	100	99.33	99.86	100	100	100	100	100	99.87	100.00	99.87	99.83
10M Wind Direction	100	100	99.33	99.86	100	100	100	100	100	99.87	100.00	99.87	99.91
10M Ambient Air Temp	100	100	99.33	99.86	100	100	97.31	100	100	99.87	100.00	99.87	99.69
10M Dew Point Temp	99.33	100	99.06	99.861	100	100	99.87	100	100	99.87	100.00	99.87	99.82
Delta T (100M-10M)	100	100	99.33	99.86	100	100	97.45	100	100	99.87	100.00	99.87	99.70
Delta T (75M-10M)	100	100	99.33	99.86	100	99.86	97.31	99.97	100	99.87	100.00	99.87	99.66
Joint 100M Winds and Delta T (100M-10M)	100	100	53.63	55.83	100	100	97.45	100	100	99.87	100.00	99.87	92.22
Joint 75M Winds and Delta T (100M-10M)	100	99.85	99.33	99.86	100	100	97.45	100	100	99.87	100.00	99.87	99.69
Joint 10M Winds and Delta T (75M-10M)	100	99.85	99.33	99.86	100	99.86	97.31	99.87	100	99.87	100.00	99.87	99.65

*all data for individual months expressed as percent of time instrument was operable during the month, divided by the maximum number of hours in that month that the instrument could be operable. Values for annual data recoveries equals the percent of time instrument was operable during the year, divided by the number of hours in the year that the instrument was operable.

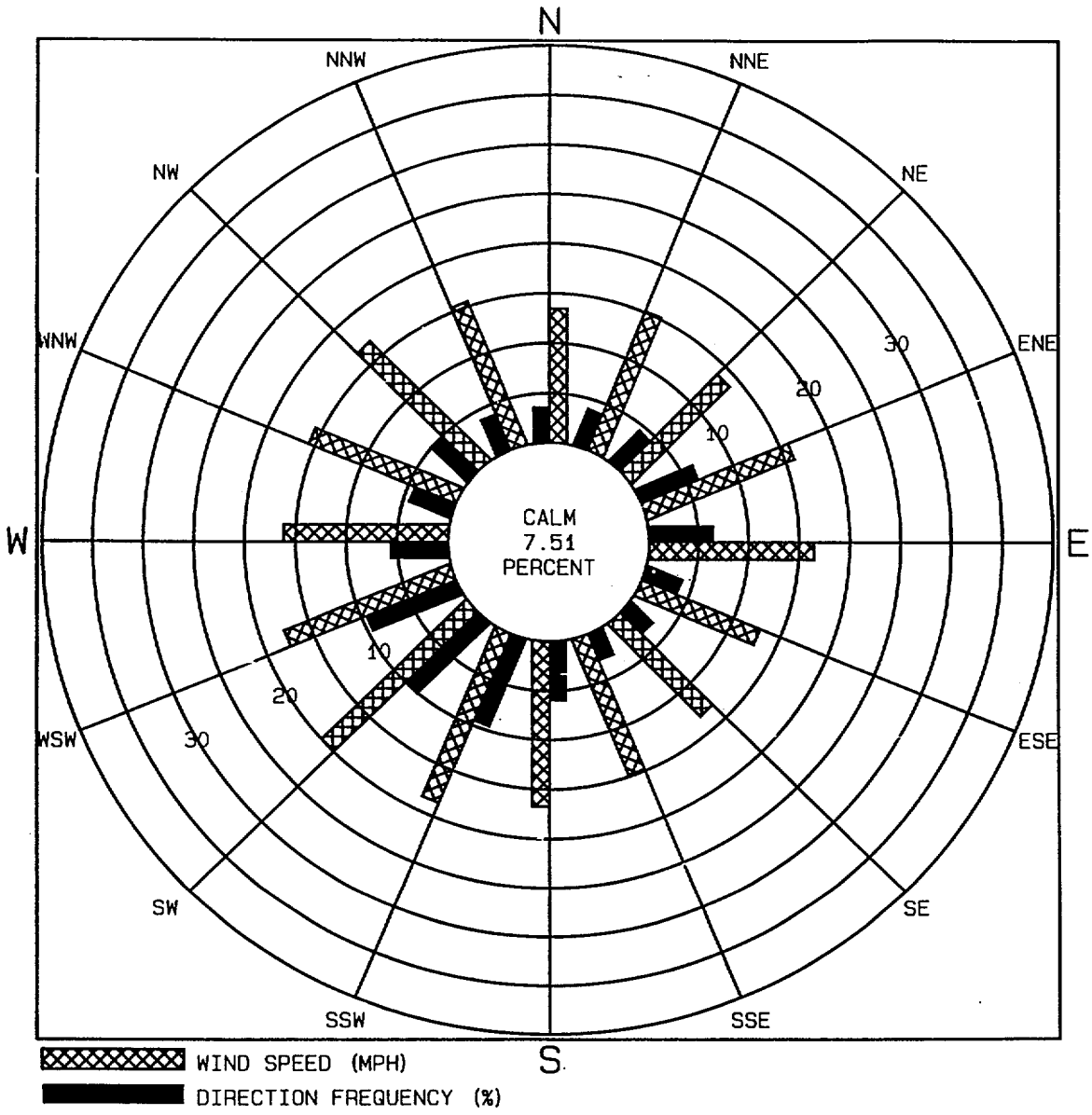
Table 29
Summary of Meteorological Data Measured for 1999

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1999
100M WIND													
Max Speed (mph)	45.36	41.72	36.62	NA	36.06	32.69	30.69	30.18	33.03	41.22	34.87	44.01	45.36
Date of Max Speed	01/02	02/11	03/09	NA	05/06	06/11	07/01	08/10	09/29	10/13	11/03	12/26	01/02
Min Speed (mph)	2.57	1.81	1.87	NA	2.34	2.21	1.99	2.06	1.42	1.34	1.76	1.94	1.34
Date of Min Speed	01/08	02/05	03/07	NA	05/23	06/25	07/26	08/26	09/07	10/11	11/21	12/12	10/11
Ave Wind Speed	20.25	17.32	19.37	NA	17.00	13.41	14.01	13.15	14.76	17.49	18.56	18.22	16.59
75M WIND													
Max Speed (mph)	44.19	39.30	36.77	45.42	34.45	29.75	28.68	28.80	31.66	39.12	33.89	41.03	45.42
Date of Max Speed	01/02	02/11	03/09	04/06	05/06	06/29	07/09	08/10	09/29	10/13	11/03	12/26	04/06
Min Speed (mph)	0.01	1.34	1.59	2.83	2.41	1.96	1.91	1.56	1.85	1.26	1.81	2.02	0.01
Date of Min Speed	01/02	02/26	03/12	04/25	05/23	06/24	07/28	08/12	09/07	10/11	11/21	12/12	01/02
Ave Wind Speed	18.98	15.95	16.51	16.91	15.65	12.47	12.82	12.23	13.49	15.84	17.12	16.85	15.40
10M WIND													
Max Speed (mph)	32.43	27.93	26.27	35.02	25.40	21.35	22.07	20.39	21.19	25.92	25.07	30.75	35.02
Date of Max Speed	01/03	02/12	03/09	04/06	05/25	06/02	07/09	08/30	09/29	10/13	11/11	12/26	04/06
Min Speed (mph)	0.01	0.03	0.02	1.40	1.17	1.23	1.24	0.31	0.84	1.16	1.77	1.94	0.01
Date of Min Speed		02/08	03/06	04/14	05/09	06/13	07/23	08/06	09/01	10/18	11/21	12/12	01/02
Ave Wind Speed	12.68	10.21	11.16	11.73	9.51	7.76	7.87	8.16	7.81	9.27	10.33	10.59	9.75

Table 29 (continued)
Summary of Meteorological Data Measured for 1999

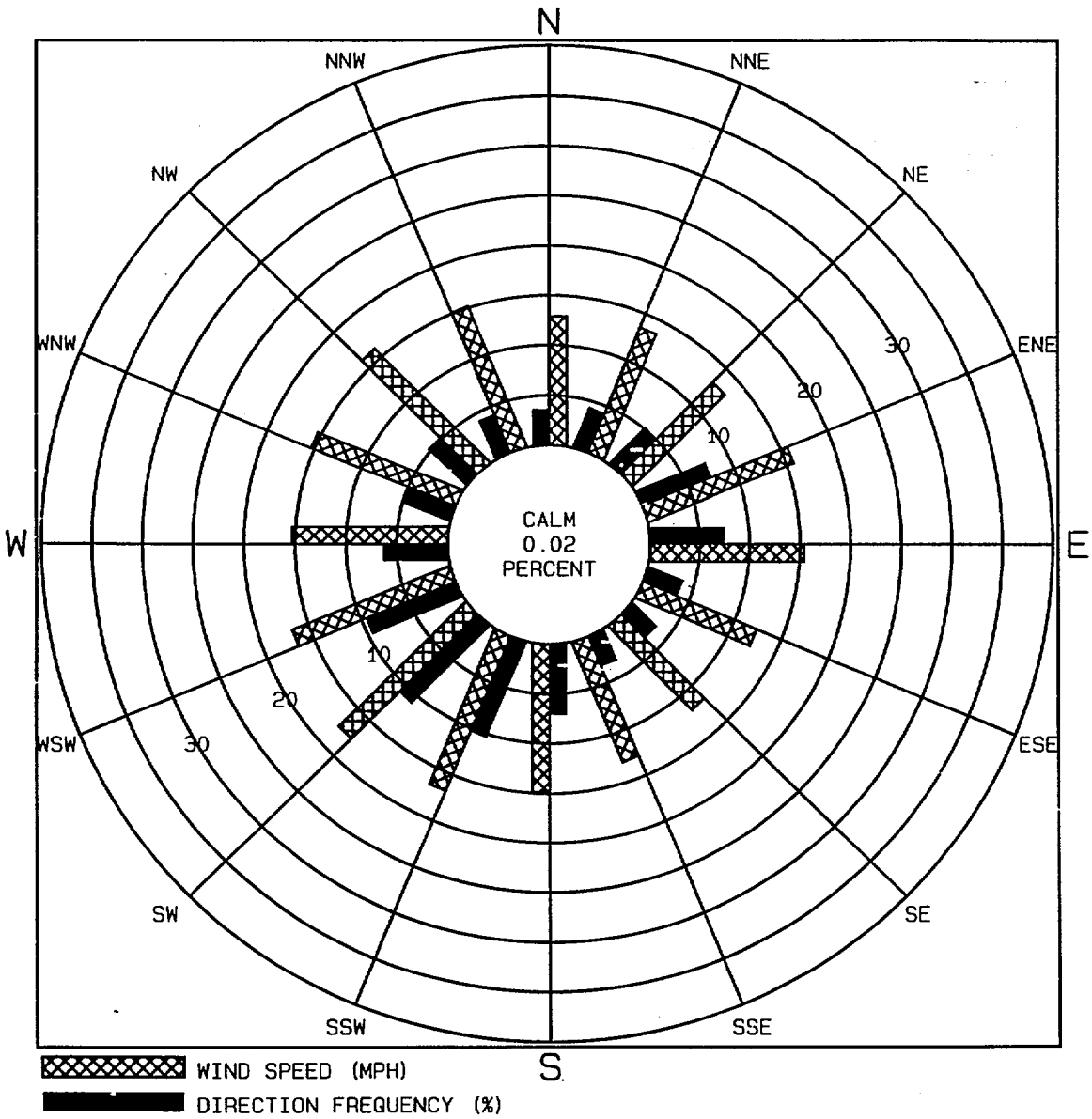
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1999
10M AMBIENT TEMP													
Max (F)	58.16	70.04	71.83	77.38	87.70	91.47	93.85	86.60	86.70	78.18	74.18	60.40	93.85
Date of Max	01/23	02/11	03/31	04/03	05/17	06/06	07/04	08/28	09/12	10/16	11/01	12/04	07/04
Min (F)	-4.84	15.00	13.51	37.86	44.80	52.07	62.01	56.33	42.56	33.59	26.55	11.31	-4.84
Date of Min	01/05	02/13	08/08	04/16	05/25	06/15	07/12	08/06	09/22	10/25	11/30	12/22	01/05
Ave Temp	24.84	33.92	34.83	49.52	61.82	71.02	77.34	70.40	66.00	53.26	45.93	33.06	51.86
10M DEW POINT TEMP													
Mean (F)	21.83	28.16	26.96	40.73	49.78	60.45	66.14	59.82	53.05	41.95	36.39	27.38	42.81
Max (F)	52.90	58.85	49.75	59.83	70.3	76.15	76.4	72.75	70.53	61.00	56.27	53.96	76.40
Date of Max	01/22	02/11	03/17	04/03	05/31	06/27	07/30	08/01	09/05	10/16	11.01	12/04	07/30
Min (F)	-5.66	2.94	12.83	25.44	37.37	37.84	51.26	29.63	33.69	28.47	17.25	6.71	-5.66
Date of Min	01/05	02/22	03/07	04/25	05/25	06/15	07/10	08/19	09/22	10/25	11/30	12/22	01/05
PRECIPITATION													
Total (inches)	2.80	2.93	1.21	4.62	1.40	2.11	1.16	3.66	1.18	2.75	2.11	1.77	27.70
Max. in One Day	0.96	1.06	0.37	1.20	0.50	0.66	0.48	1.83	1.02	1.07	1.29	0.82	1.83
Date	01/16	02/16	03/03	04/09	05/31	06/14	07/17	08/26	09/29	10/3	11/02	12/14	08/26

Figure 32
Wind Rose Annual Average 100M



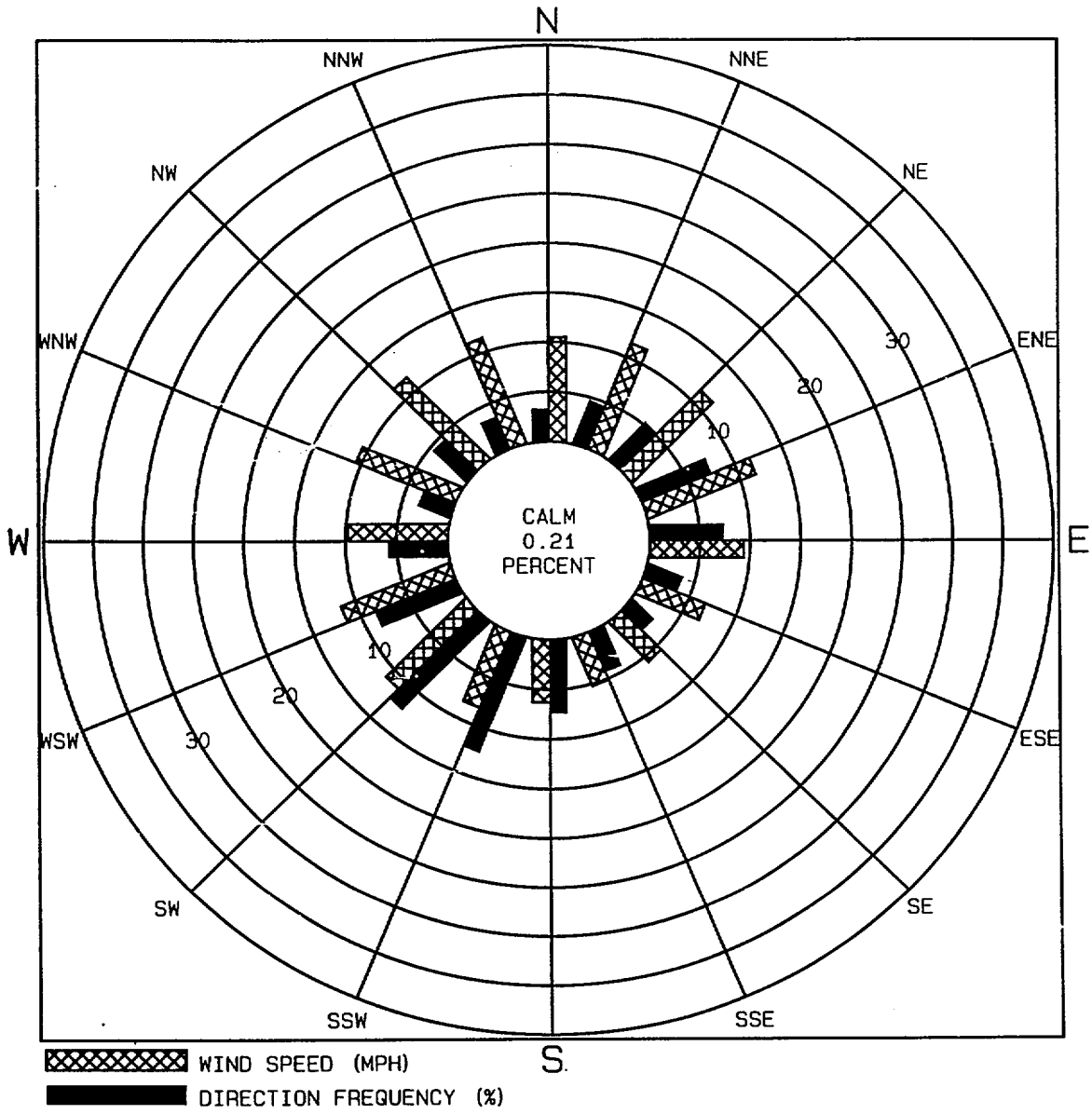
DAVIS-BESSE
ANNUAL 1999
100M LEVEL

Figure 33
Wind Rose Annual Average 75M



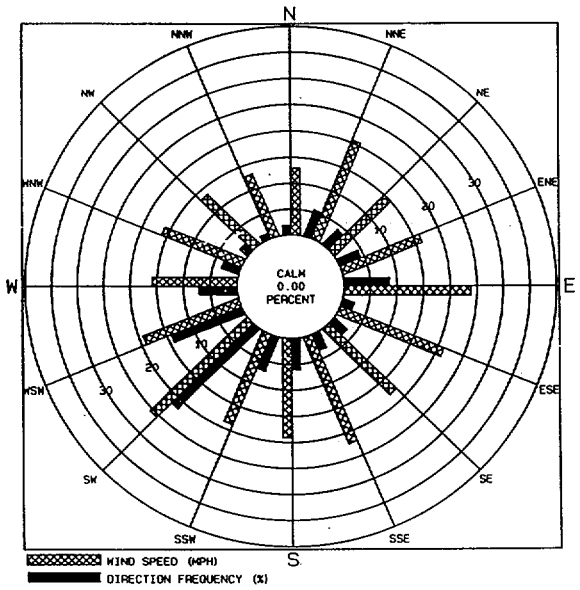
DAVIS-BESSE
ANNUAL 1999
75M LEVEL

Figure 34
Wind Rose Annual Average 10M

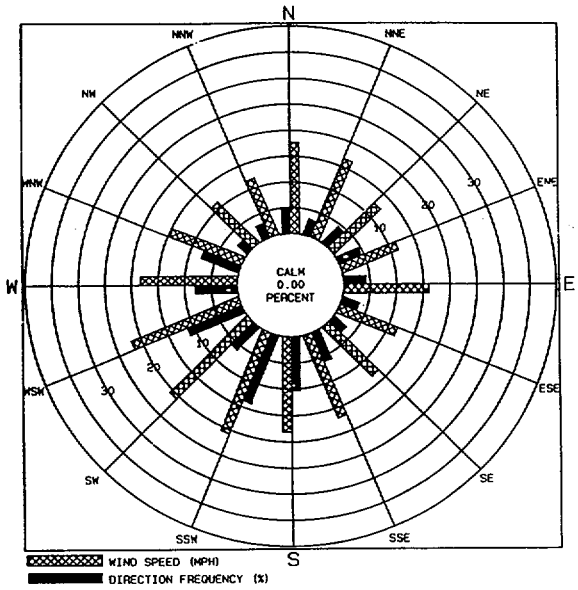


DAVIS-BESSE
ANNUAL 1999
10M LEVEL

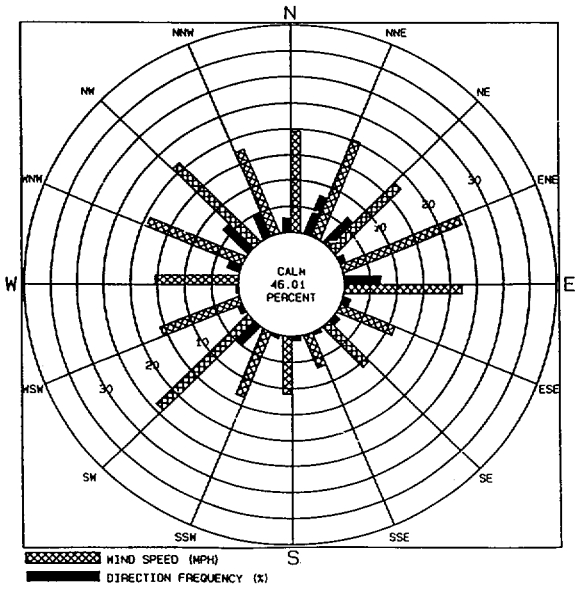
Figure 35
Wind Rose Monthly Average 100M



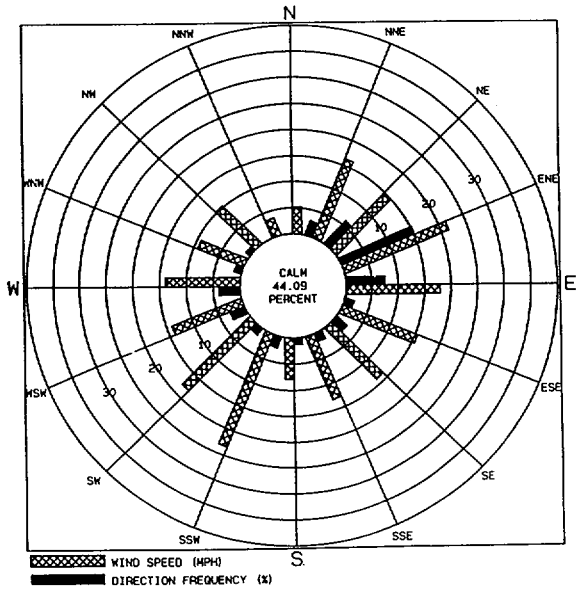
DAVIS-BESSE
JANUARY 1999
100M LEVEL



DAVIS-BESSE
FEBRUARY 1999
100M LEVEL

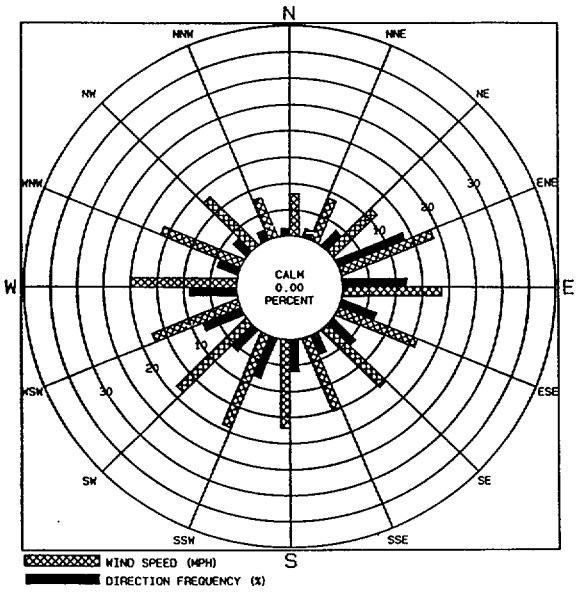


DAVIS-BESSE
MARCH 1999
100M LEVEL

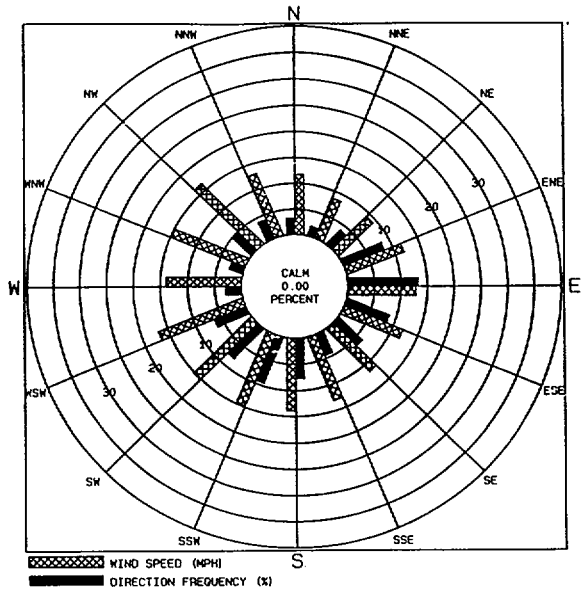


DAVIS-BESSE
APRIL 1999
100M LEVEL

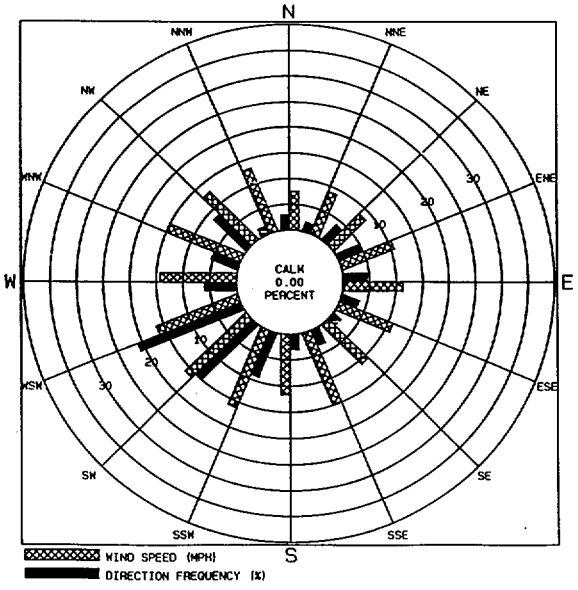
Figure 35 (continued)
Wind Rose Monthly Average 100M



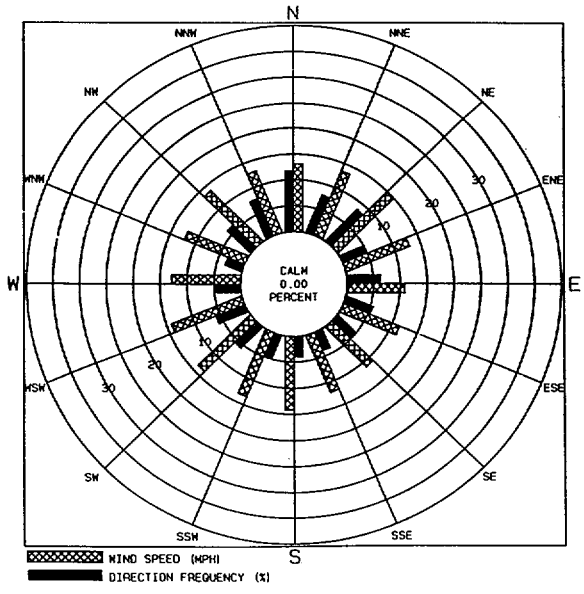
DAVIS-BESSE
MAY 1999
100M LEVEL



DAVIS-BESSE
JUNE 1999
100M LEVEL

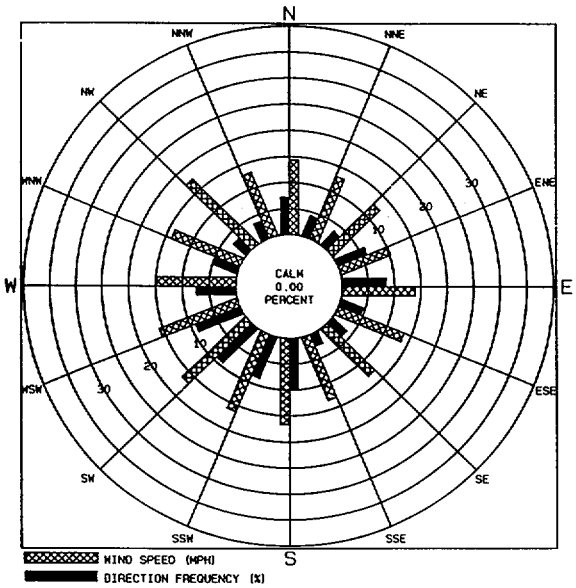


DAVIS-BESSE
JULY 1999
100M LEVEL

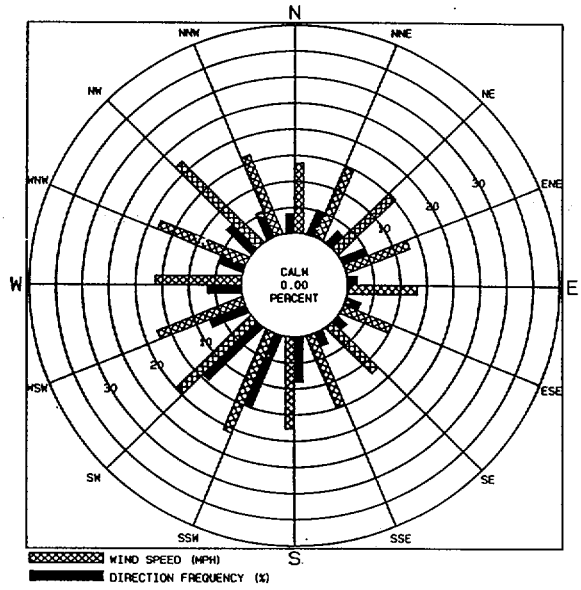


DAVIS-BESSE
AUGUST 1999
100M LEVEL

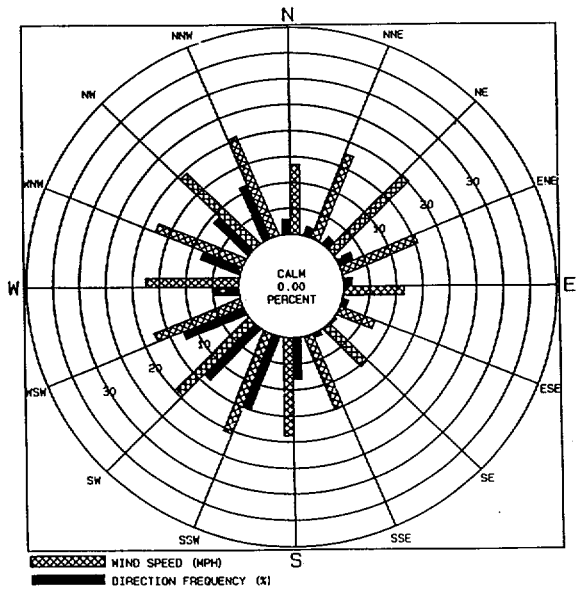
Figure 35 (continued)
Wind Rose Monthly Average 100M



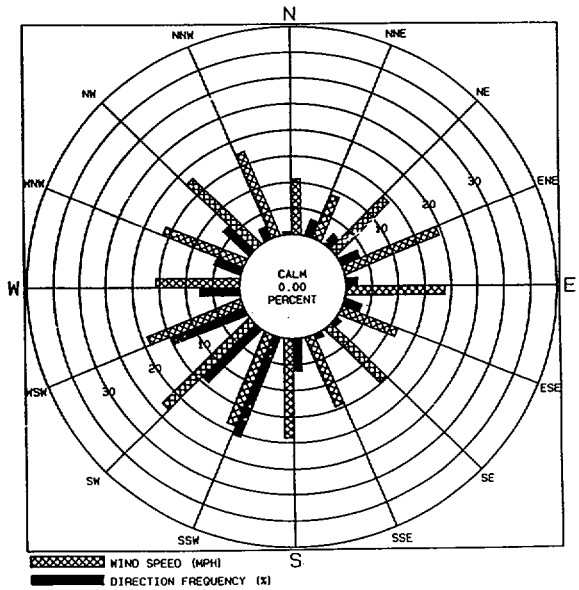
DAVIS-BESSE
SEPTEMBER 1999
100M LEVEL



DAVIS-BESSE
OCTOBER 1999
100M LEVEL

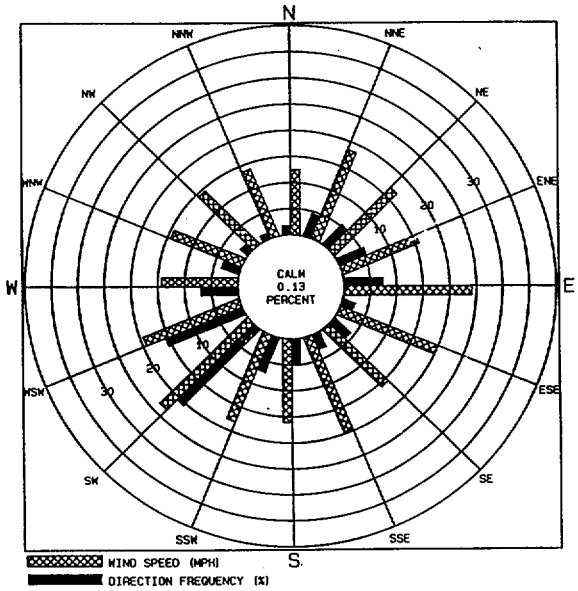


DAVIS-BESSE
NOVEMBER 1999
100M LEVEL

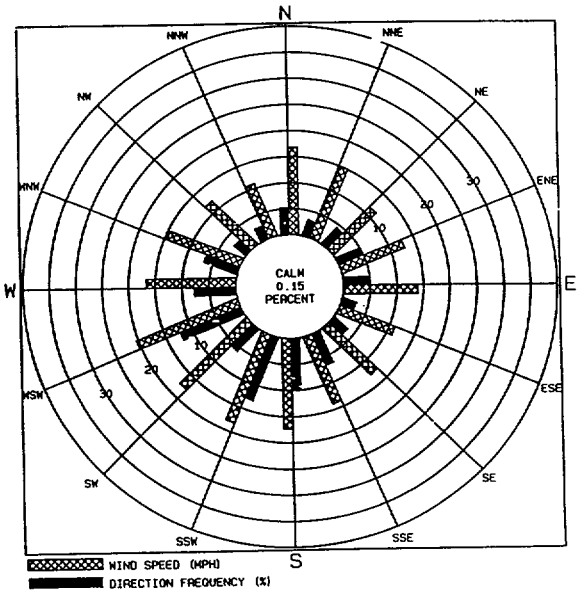


DAVIS-BESSE
DECEMBER 1999
100M LEVEL

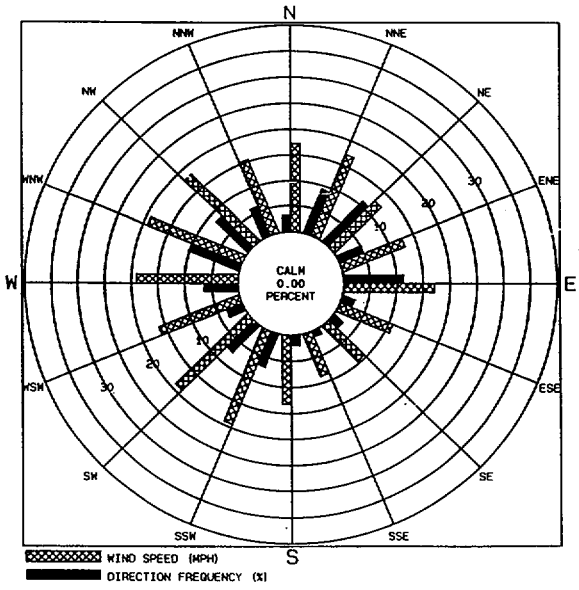
Figure 36
Wind Rose Monthly Average 75M



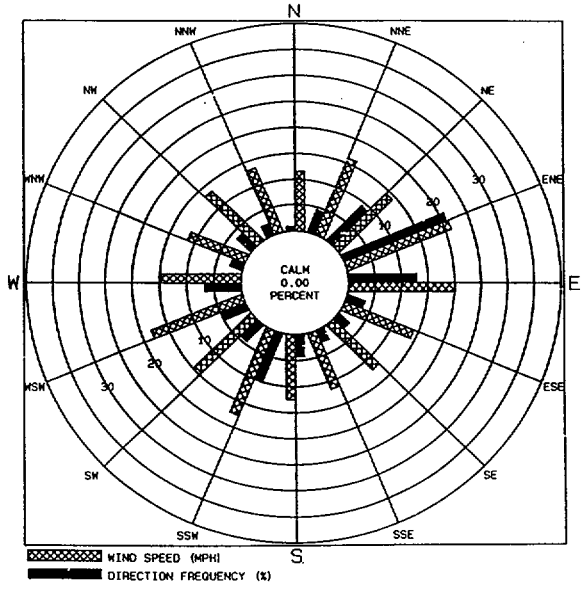
DAVIS-BESSE
JANUARY 1999
75M LEVEL



DAVIS-BESSE
FEBRUARY 1999
75M LEVEL

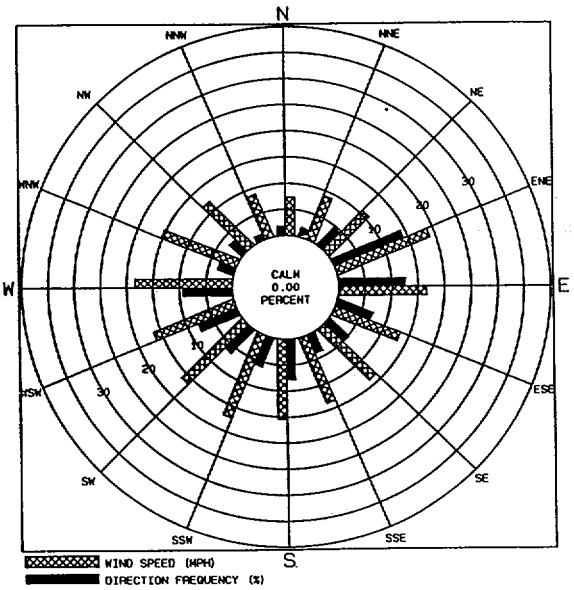


DAVIS-BESSE
MARCH 1999
75M LEVEL

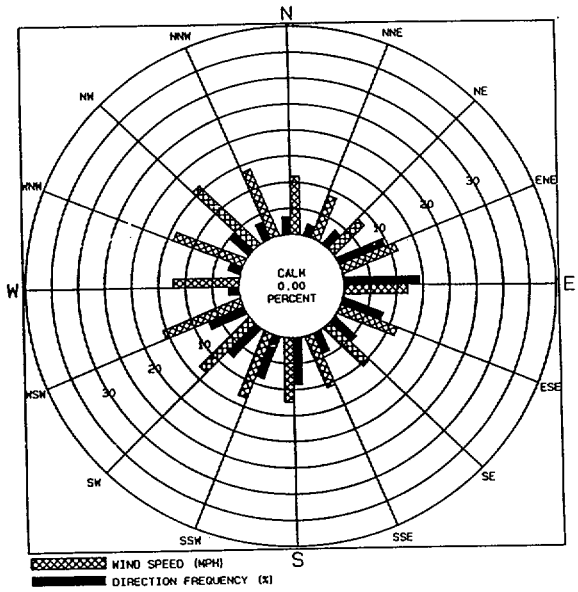


DAVIS-BESSE
APRIL 1999
75M LEVEL

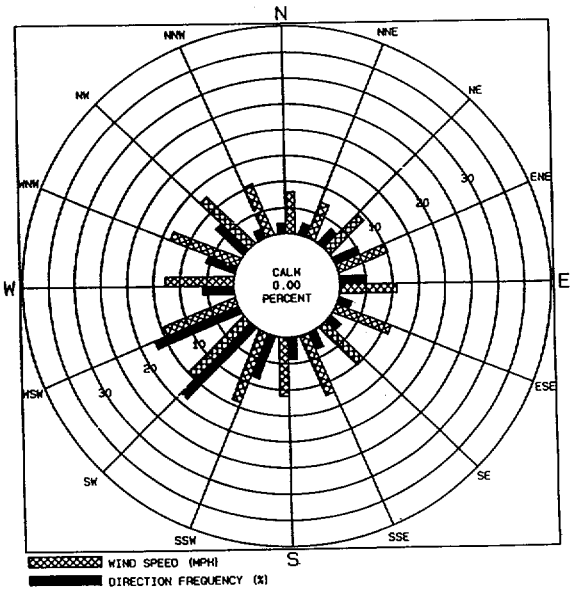
Figure 36 (continued)
Wind Rose Monthly Average 75M



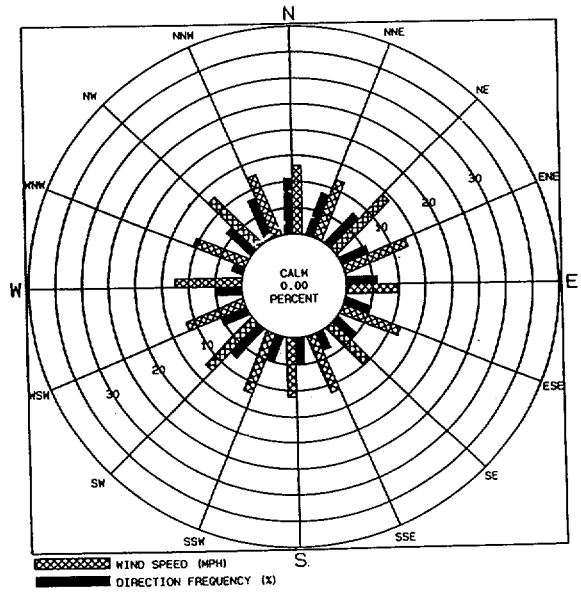
DAVIS-BESSE
MAY 1999
75M LEVEL



DAVIS-BESSE
JUNE 1999
75M LEVEL

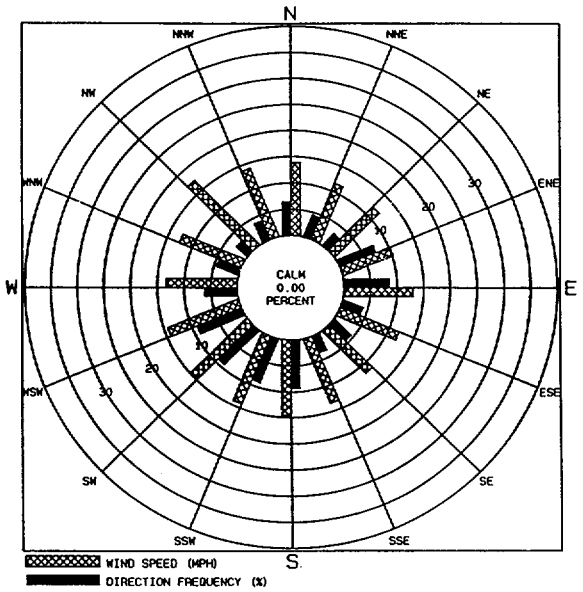


DAVIS-BESSE
JULY 1999
75M LEVEL

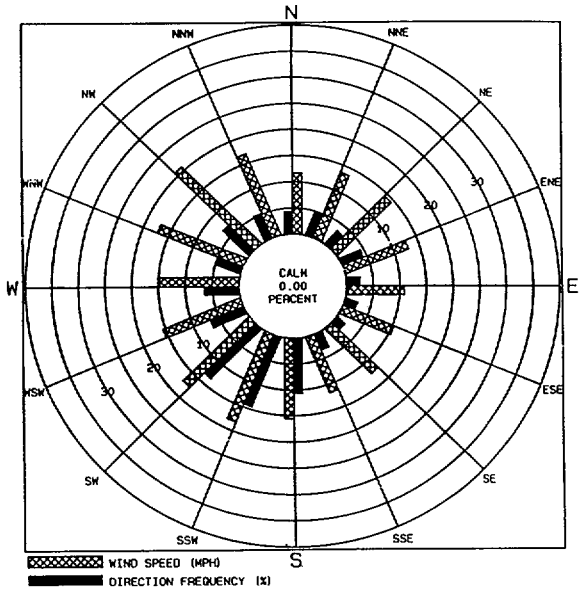


DAVIS-BESSE
AUGUST 1999
75M LEVEL

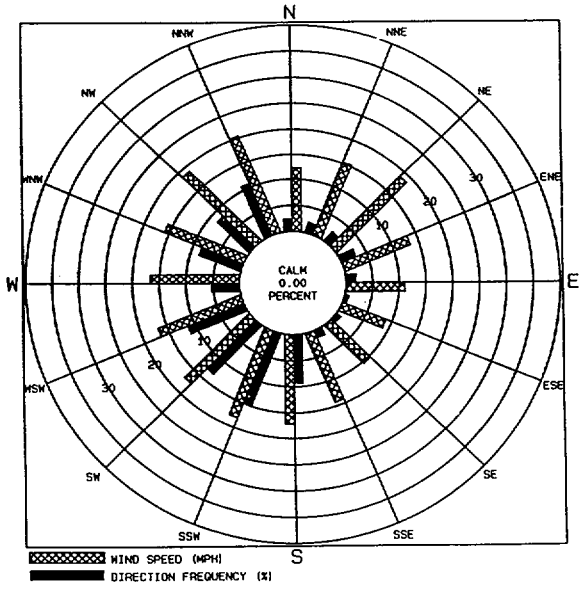
Figure 36 (continued)
Wind Rose Monthly Average 75M



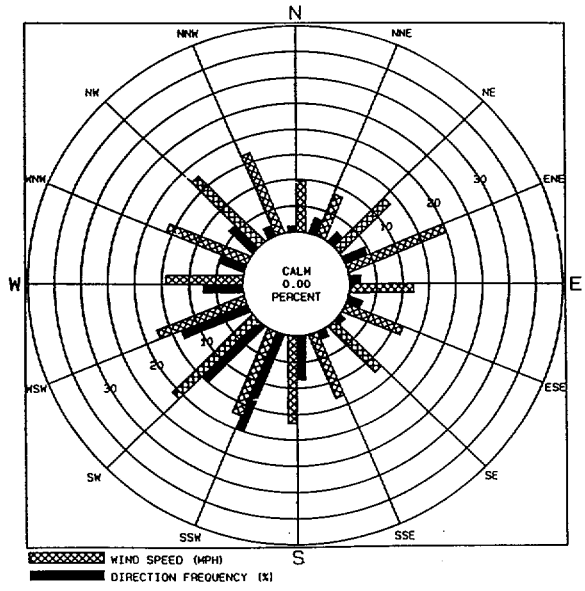
DAVIS-BESSE
SEPTEMBER 1999
75M LEVEL



DAVIS-BESSE
OCTOBER 1999
75M LEVEL

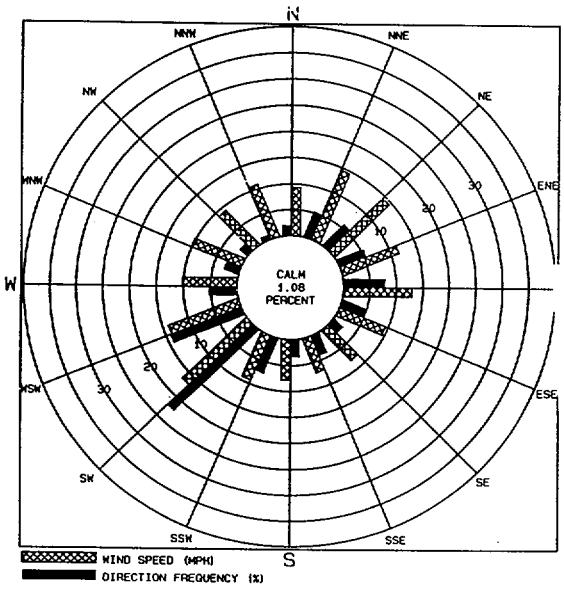


DAVIS-BESSE
NOVEMBER 1999
75M LEVEL

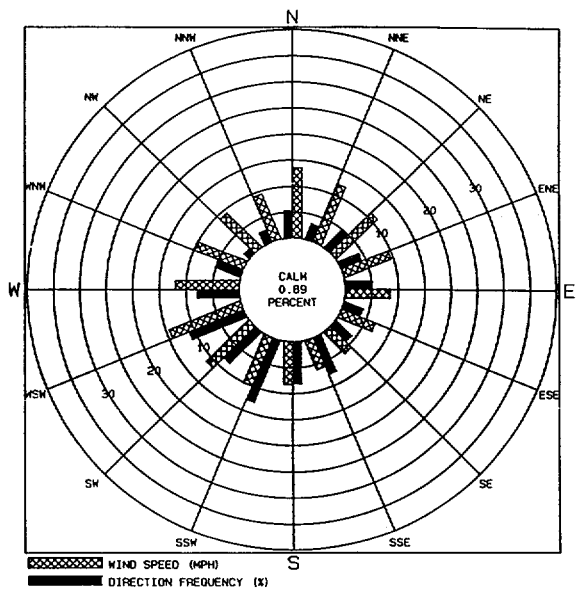


DAVIS-BESSE
DECEMBER 1999
75M LEVEL

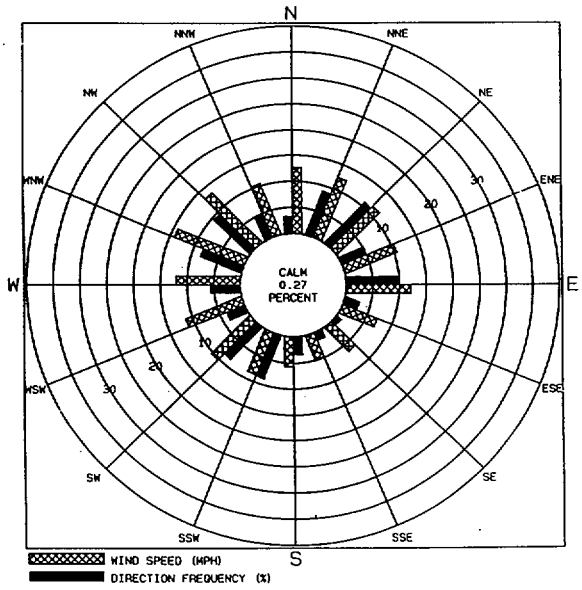
Figure 37
Wind Rose Monthly Average 10M



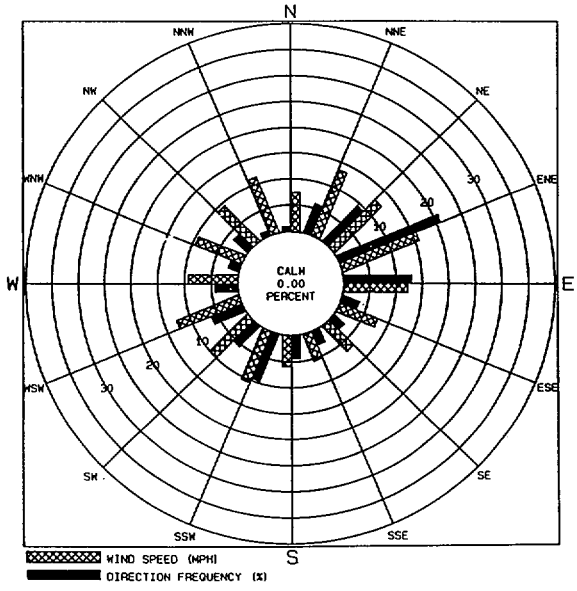
DAVIS-BESSE
JANUARY 1999
10M LEVEL



DAVIS-BESSE
FEBRUARY 1999
10M LEVEL

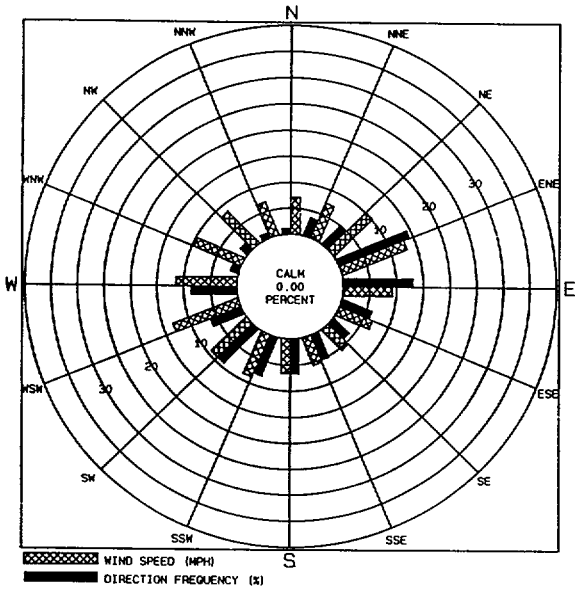


DAVIS-BESSE
MARCH 1999
10M LEVEL

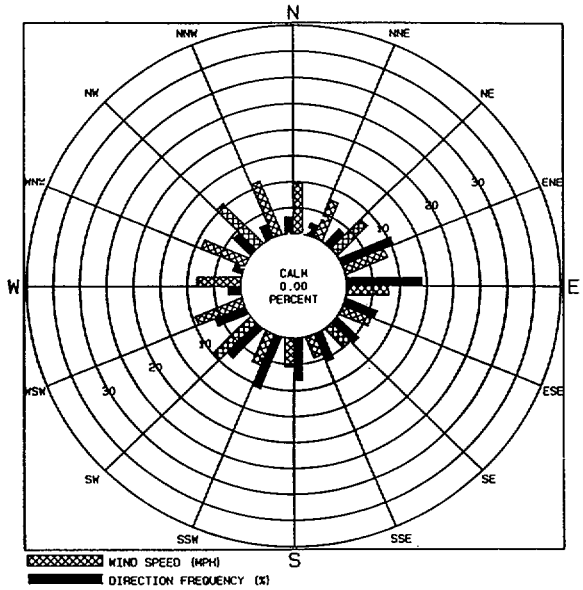


DAVIS-BESSE
APRIL 1999
10M LEVEL

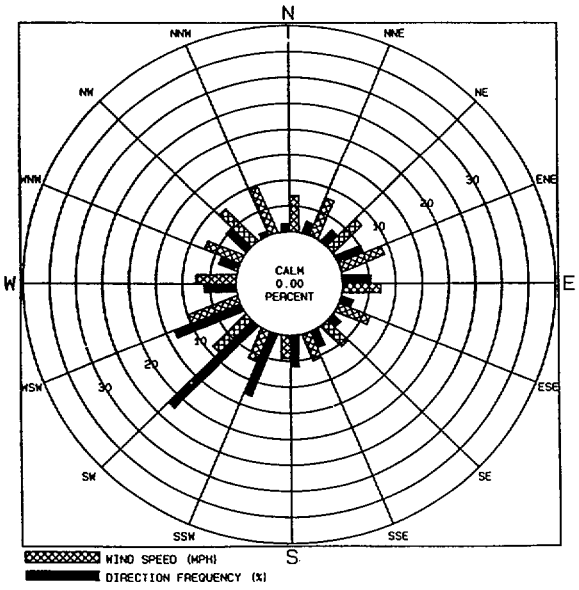
Figure 37 (continued)
Wind Rose Monthly Average 10M



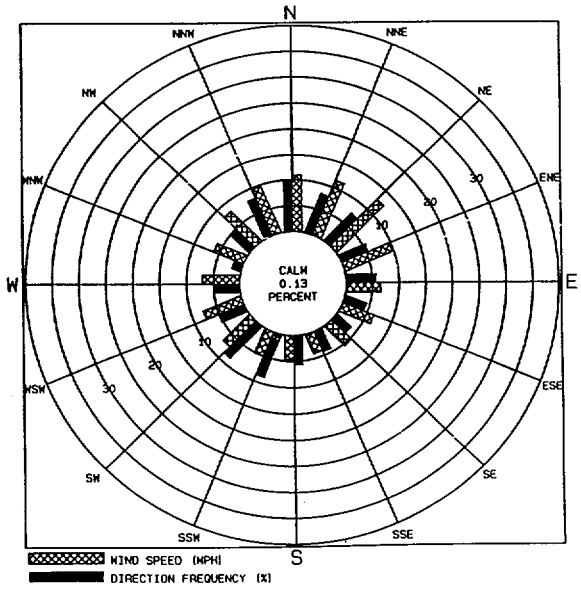
DAVIS-BESSE
MAY 1999
10M LEVEL



DAVIS-BESSE
JUNE 1999
10M LEVEL

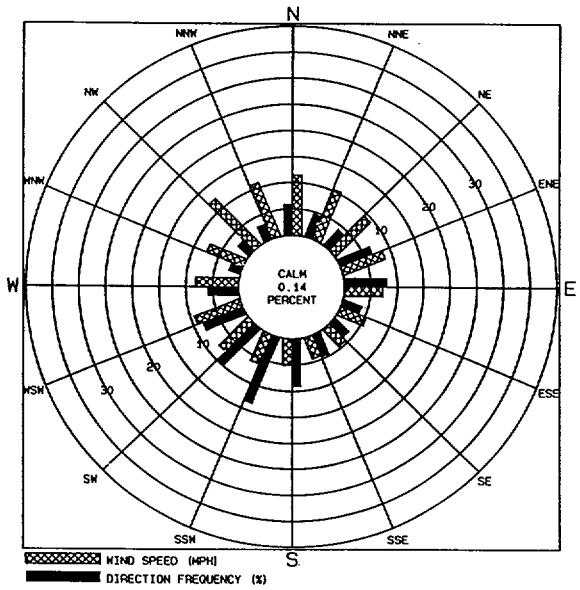


DAVIS-BESSE
JULY 1999
10M LEVEL

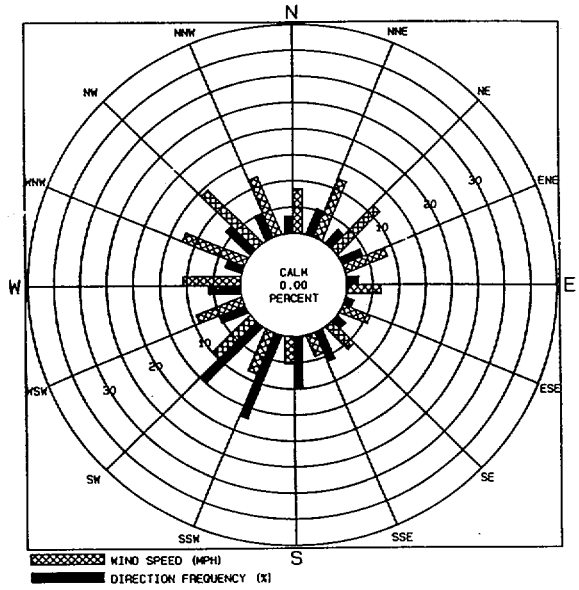


DAVIS-BESSE
AUGUST 1999
10M LEVEL

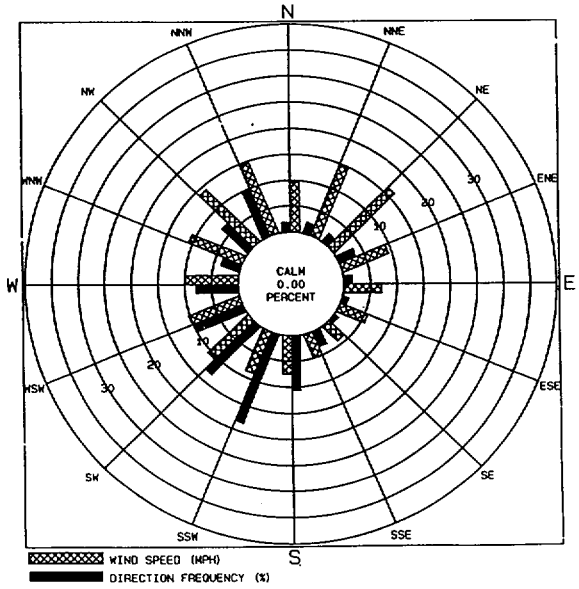
Figure 37 (continued)
Wind Rose Monthly Average 10M



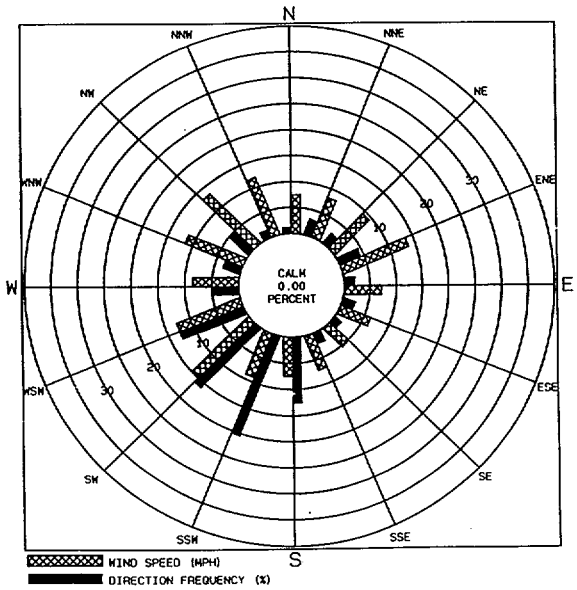
DAVIS-BESSE
SEPTEMBER 1999
10M LEVEL



DAVIS-BESSE
OCTOBER 1999
10M LEVEL



DAVIS-BESSE
NOVEMBER 1999
10M LEVEL



DAVIS-BESSE
DECEMBER 1999
10M LEVEL

Table 30
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * ** 4-JAN-00 PAGE 91

TIME OF DAY: 10:29:31

PROGRAM: JFD VERSION: F77-1.0

******** DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 99

DATA PERIOD EXAMINED: 1/ 1/ 99 - 12/ 31/ 99

*** ANNUAL ***

STABILITY CLASS A

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

WIND MEASURED AT: 35.0 FEET

WIND THRESHOLD AT: 1.00 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
1.01- 3.49	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
3.50- 7.49	21	13	2	2	0	0	0	0	1	0	3	0	0	2	10	11	65
7.50-12.49	16	3	1	0	0	1	0	0	4	6	1	3	2	3	1	6	47
12.50-18.49	4	0	0	1	0	0	0	0	0	3	5	3	1	0	1	2	20
18.50-24.49	1	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	5
>24.49	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	42	17	4	4	0	2	0	0	5	9	12	6	3	5	12	19	140

STABILITY CLASS B

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

WIND MEASURED AT: 35.0 FEET

WIND THRESHOLD AT: 1.00 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
1.01- 3.49	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
3.50- 7.49	8	6	1	0	0	2	0	0	3	3	2	5	1	1	3	6	41
7.50-12.49	21	8	2	6	4	1	1	0	2	10	12	10	6	2	9	11	105
12.50-18.49	5	2	4	13	3	0	0	0	0	6	17	13	2	1	3	5	74
18.50-24.49	1	0	0	5	0	0	0	0	0	1	1	2	0	0	0	0	10
>24.49	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	35	18	8	24	7	3	1	0	5	20	32	30	9	4	16	22	234

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * ** 4-JAN-00 PAGE 92

TIME OF DAY: 10:29:31

PROGRAM: JFD VERSION: F77-1.0

******* DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 99

DATA PERIOD EXAMINED: 1/ 1/ 99 - 12/ 31/ 99

*** ANNUAL ***

STABILITY CLASS C

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

WIND MEASURED AT: 35.0 FEET

WIND THRESHOLD AT: 1.00 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	0
1.01- 3.49	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2
3.50- 7.49	6	6	6	0	2	1	4	4	9	11	12	5	0	6	3	6	81
7.50-12.49	8	10	18	20	13	2	3	0	8	28	27	23	7	5	22	20	214
12.50-18.49	9	3	5	16	7	0	0	0	1	10	21	23	7	9	8	9	128
18.50-24.49	1	0	0	5	1	0	0	0	0	1	4	4	1	1	0	0	18
>24.49	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	3
TOTAL	24	19	29	42	23	3	7	5	18	50	66	56	15	21	33	35	446

STABILITY CLASS D

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

WIND MEASURED AT: 35.0 FEET

WIND THRESHOLD AT: 1.00 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	6
1.01- 3.49	2	4	5	4	8	2	6	3	6	12	4	2	7	5	3	2	75
3.50- 7.49	28	45	54	64	105	43	33	37	56	78	46	34	23	22	26	18	712
7.50-12.49	55	103	150	202	142	32	20	31	50	160	131	146	99	49	90	63	1523
12.50-18.49	65	100	97	131	73	9	2	2	10	80	123	143	72	70	79	97	1153
18.50-24.49	15	41	49	53	19	6	0	0	0	13	67	53	24	18	40	15	413
>24.49	0	2	3	12	7	0	0	0	0	0	37	19	0	0	0	0	80
TOTAL	165	295	358	466	354	92	61	73	122	343	408	397	225	164	238	195	3962

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * ** 4-JAN-00 PAGE 93

TIME OF DAY: 10:29:31

PROGRAM: JFD VERSION: F77-1.0

******* DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 99

DATA PERIOD EXAMINED: 1/ 1/ 99 - 12/ 31/ 99

*** ANNUAL ***

STABILITY CLASS E

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

WIND MEASURED AT: 35.0 FEET

WIND THRESHOLD AT: 1.00 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	3
1.01- 3.49	3	3	2	5	13	17	19	31	22	24	13	9	8	5	3	3	180
3.50- 7.49	22	19	18	55	94	90	99	111	142	145	111	66	61	24	25	13	1095
7.50-12.49	7	20	29	52	87	50	19	31	72	207	123	91	83	44	36	32	983
12.50-18.49	3	18	4	15	21	2	0	4	15	38	59	31	21	12	18	5	266
18.50-24.49	0	3	0	2	7	0	0	0	2	5	41	15	5	3	10	0	93
>24.49	0	0	0	1	1	0	0	0	0	0	0	4	0	1	0	0	7
TOTAL	35	63	53	130	223	159	137	177	253	419	347	216	178	89	92	53	2627

STABILITY CLASS F

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

WIND MEASURED AT: 35.0 FEET

WIND THRESHOLD AT: 1.00 MPH

JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	1
1.01- 3.49	3	3	2	3	3	2	8	41	39	33	23	25	8	3	7	3	206
3.50- 7.49	1	2	4	7	16	52	28	60	120	147	96	40	55	22	2	1	653
7.50-12.49	0	2	2	6	12	12	3	6	8	26	24	15	13	7	0	0	136
12.50-18.49	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
18.50-24.49	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
>24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4	7	8	16	31	67	40	107	167	206	144	80	76	32	9	4	999

Table 30 (continued)
Joint Frequency Distribution by Stability Class

ROGRAM: JFD VERSION: F77-1.0

******* DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 99

ATA PERIOD EXAMINED: 1/ 1/ 99 - 12/ 31/ 99

*** ANNUAL ***

STABILITY CLASS G

TABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET
IND MEASURED AT: 35.0 FEET
IND THRESHOLD AT: 1.00 MPH
OINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	1
1.01- 3.49	1	1	0	0	2	5	4	14	26	20	7	12	2	2	1	1	98
3.50- 7.49	1	0	0	1	13	17	10	24	22	49	41	10	11	1	1	0	201
7.50-12.49	0	0	1	1	0	3	2	0	1	0	2	2	3	0	0	0	15
.2.50-18.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.8.50-24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
>24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	1	1	2	15	25	16	38	49	69	50	24	16	3	2	1	315

STABILITY CLASS ALL

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: 1.00 MPH
JOINT FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION IN HOURS AT 35.00 FEET

SPEED (MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	11
1.01- 3.49	9	13	10	12	26	27	37	90	93	89	48	48	25	15	15	9	566
3.50- 7.49	87	91	85	129	230	205	174	236	353	433	311	160	151	78	70	55	2848
7.50-12.49	107	146	203	287	258	101	48	68	145	437	320	290	213	110	158	132	3023
12.50-18.49	86	123	110	176	104	12	2	6	26	137	226	213	103	92	109	118	1643
18.50-24.49	18	44	49	66	27	6	1	0	2	20	116	74	30	22	50	15	540
>24.49	0	3	4	14	8	0	0	0	0	0	38	24	0	1	0	0	92
TOTAL	307	420	461	684	653	351	262	400	619	1116	1059	809	522	318	402	329	8723

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * ** 4-JAN-00 PAGE 95

TIME OF DAY: 10:29:31

OGRAM: JFD VERSION: F77-1.0

****** DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 99

TA PERIOD EXAMINED: 1/ 1/ 99 - 12/ 31/ 99

*** ANNUAL ***

ABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET

ND MEASURED AT: 35.0 FEET

ND THRESHOLD AT: 1.00 MPH

TAL NUMBER OF OBSERVATIONS: 8759

TAL NUMBER OF VALID OBSERVATIONS: 8723

TAL NUMBER OF MISSING OBSERVATIONS: 36

RCENT DATA RECOVERY FOR THIS PERIOD: 99.6 %

AN WIND SPEED FOR THIS PERIOD: 9.8 MPH

TAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
1.60	2.68	5.11	45.42	30.12	11.45	3.61

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	42	17	4	4	0	2	0	0	5	9	12	6	3	5	12	19	0
B	35	18	8	24	7	3	1	0	5	20	32	30	9	4	16	22	0
C	24	19	29	42	23	3	7	5	18	50	66	56	15	21	33	35	0
D	165	295	358	466	354	92	61	73	122	343	408	397	225	164	238	195	6
E	35	63	53	130	223	159	137	177	253	419	347	216	178	89	92	53	3
F	4	7	8	16	31	67	40	107	167	206	144	80	76	32	9	4	1
G	2	1	1	2	15	25	16	38	49	69	50	24	16	3	2	1	1
TOTAL	307	420	461	684	653	351	262	400	619	1116	1059	809	522	318	402	329	11

Land and Wetlands Management

The Navarre Marsh, which is part of the Ottawa National Wildlife Refuge, makes up 733 acres of wetlands on the southwestern shore of Lake Erie and surrounds the Davis-Besse Nuclear Power Station. The marsh is owned by Toledo Edison and jointly managed by the U.S. Fish and Wildlife Service and Toledo Edison. Navarre Marsh is divided into three pools (units). The pools are separated from Lake Erie and each other by a series of dikes and revetments. Toledo Edison is responsible for the maintenance and repair of the dikes and controlling the water levels in each pool.

A revetment is a retaining structure designed to hold water back for the purpose of erosion control and to encourage beach formation. Revetments are built with a gradual slope which causes waves to dissipate their energy when they strike the revetment. This encourages beach formation through passive deposition of sediment. A dike is a retaining structure designed to hold back water for the purpose of flood control and to aid in managing wetland habitat. When used as a marsh management tool, dikes aid in controlling water levels in order to obtain desired vegetation and animal species. Manipulating water levels is one of the most important marsh management tools used in Navarre Marsh. Three major types of wetland communities exist in Navarre Marsh, the freshwater marsh, swamp forest, and wet meadow. Also, there exists a narrow dry beach ridge along the lakefront with a sandbar extending out into Lake Erie. All these areas provide essential food, shelter, and nesting habitat as well as a resting area for migratory birds.

Davis-Besse personnel combine their efforts with a number of conservation agencies and organizations. The Ottawa National Wildlife Refuge, the Ohio Department of Natural Resources (ODNR), and the Black Swamp Bird Observatory work to preserve and enhance existing habitat. Knowledge is gained through research and is used to help educate the public about the importance of preserving wetlands.

With its location along two major migratory flyways, the Navarre Marsh serves as a refuge for a variety of birds in the spring and the fall, where they rest and build up energy reserves before continuing their journey. The Black Swamp Bird Observatory captures, examines, bands, catalogues, and releases songbirds in the marsh during these periods.

Navarre Marsh is also home to wildlife that is typical of much of the marshland in this area, including deer, fox, coyote, muskrats, mink, rabbits, woodchucks, eagles, hawks, owls, ducks, geese, herons, snakes and turtles. For the first time in recent history, a pair of mature American Bald Eagles chose the Navarre Marsh as their nesting site in late 1994, and fledged a healthy eaglet in July 1995. The young eagle was one of record 38 eaglets fledged in Ohio in 1995. The nest blew down in a storm in August of 1995, and State and Federal wildlife officials and Davis-Besse employees constructed an artificial nesting platform. This nest was the only one in Ottawa County to survive the June 1998 severe weather.

Goose banding took place in June, and was conducted in cooperation with the ODNR and the U.S. Fish and Wildlife Service. Over 100 Canada Geese were banded in about an hour.

Ohio's fifth Federal Junior Duck Stamp Art Contest was hosted by Davis-Besse. Young Ohio artists in grades K-12 submitted nearly 800 entries in four separate age brackets. The Junior Duck Stamp Art Contest was designed to teach conservation through the arts and give students a chance to experience the beauty and diversity of wildlife. A total of 101 ribbons were awarded to young Ohio artists, with the state Best of Show entry submitted to Washington, D.C. to compete in the national contest with all other state best-of-show entries. The winner of this competition will be used to make this year's Junior Duck Stamp. The 1996 Ohio Junior Duck Stamp Art Contest winner of Best of Show, Adam Grimm, became the youngest artist ever to win the Federal Duck Stamp contest. His artwork will be displayed on the federal duck stamp for the year 2000.

Davis-Besse also hosted a Volunteer Eagle Watchers Workshop. Training was given to over 80 volunteers who will be observing Ohio's expanding eagle population during the current breeding and nesting season.

Water Treatment Plant Operation

Description

The Davis-Besse Nuclear Power Station utilizes water from Lake Erie for its water treatment plant. The lake water is treated with chlorine, lime, and other chemicals to produce high purity water, which is used by many of the Station's cooling systems.

Treatment System

Raw water from Lake Erie enters an intake structure, then passes through traveling screens which will remove debris greater than one-half inch in size. The water is then pumped to chlorine detention tanks. Next, the water passes through one of two clarifiers. Davis-Besse uses upflow clarifiers, or precipitators, to remove sediment, organic debris, and dissolved agents from the raw water prior to filtration. Clarifiers combine the conventional treatment steps of coagulation, flocculation, and sedimentation into a single unit. Coagulation is the process by which a chemical, called a coagulant, is added, causing the small particles in the water to adhere to each other and form larger particles. During flocculation, the water is gently circulated, allowing these conglomerate particles to mass together further. Finally, during sedimentation, large conglomerate particles settle to the bottom of the clarifier. These processes normally require large separate tanks. However, the use of clarifiers saves both space and the manpower needed to operate the treatment plant.

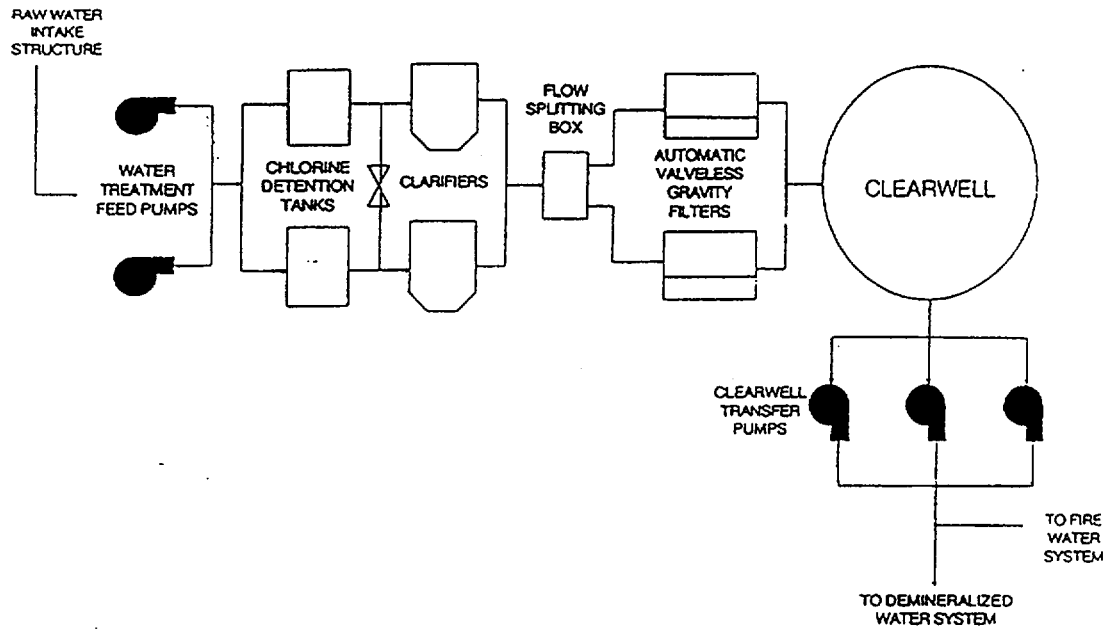


Figure 38: At Davis-Besse, raw water is drawn into the water treatment plant and processed to make water for plant systems.

After the clarifier, the water goes through a flow-splitting box, which equally divides the water flow to the Automatic Valveless Gravity Filters (AVGF). These AVGFs consist of a 50:50 ratio of anthracite to filter sand. During this filtration process, suspended matter is removed from the water by the anthracite and sand media. This filtering reduces the turbidity of the water.

After filtration, the water goes to a 32,000-gallon clearwell. The clearwell acts as a reservoir from which water can be drawn as needed for all systems, including firewater and demineralized water.

Domestic Water

Since Davis-Besse began operation over 20 years ago, all site domestic water was produced in the Water Treatment Facility. Operation of the Domestic Water Treatment and Distribution System, including the collection and analysis of daily samples, has been reportable to the Ohio Environmental Protection Agency.

Beginning in December 1998, domestic water needs at Davis-Besse have been met by the Carroll Township Water District. Since the Station no longer produces its own domestic water, these regulatory requirements have been discontinued.

Zebra Mussel Control

Introduction

The plant receives all of its water from an intake system from Lake Erie. Zebra mussels can severely impact the availability of water for plant processes. *Dreissena polymorpha*, commonly known as the zebra mussel, is a native European bivalve that was accidentally introduced into

North American waters in 1986 and was discovered in Lake Erie in 1989. Zebra mussels are prolific breeders that rapidly colonize an area by secreting byssal threads that enable them to attach to solid surfaces and to each other. Because of their ability to attach in this manner, they may form layers several inches deep. This poses a problem to facilities that rely on water intakes from Lake Erie because mussels may attach to the intake structures and restrict water flow.

Zebra mussels have not caused any significant problems at Davis-Besse, but mussels have been found attached to the intake crib (the structure that allows water to be pulled in from the lake) and the first section of the intake conduit (the pipe that connects the crib to the intake canal).

Mussels have also been found on the trash racks, and the intake bay #3 walls prior to the traveling screens. These mussels are periodically cleaned using high-pressure water. Davis-Besse uses continuous low level chlorination of the intake bays to control the mussels.

The mussel population appears to be leveling off or declining. This is likely due to the increasing clarity of Lake Erie. As the food source for the zebra mussel declines, mussel population declines correspondingly.

Wastewater Treatment Plant Operation

The WWTP operation is supervised by a state Certified Wastewater Operator. Wastewater generated by site personnel is treated at an onsite extended aeration package treatment facility designed to accommodate a flow of 38,000 gallons per day (gpd). In the treatment process, wastewater from the various collection points around the site, called lift stations, enters the facility and is distributed to the surge tanks of the treatment plants

The wastewater is then pumped into the aeration tanks. Here, sanitary waste is digested by microorganisms, which are provided with a source of oxygen. This is accomplished by the use of blowers. The mixture of organics, microorganisms, and decomposed wastes is called activated sludge. The treated wastewater settles in a clarifier, and the clear liquid passes over a weir, leaving the plant by an effluent trough. The activated sludge contains the organisms necessary for continued treatment, and is pumped back to the front of the plant to digest more incoming wastewater. The effluent leaving the plant is disinfected with chlorine and is pumped to the wastewater treatment basin (NPDES Outfall 601) where further treatment takes place.

Summary of 1999 Wastewater Treatment Plant Operations

A new building was erected around the #1 Wastewater Treatment Plant, to replace the building that sustained damage during the 1998 tornado event. All other wastewater operations were normal during 1999.

National Pollutant Discharge Elimination System (NPDES) Reporting

The OEPA has established limits on the amount of pollutants that Davis-Besse may discharge to the environment. These limits are regulated through the Station's National Pollutant Discharge Elimination System (NPDES) permit, number 2IB00011 * FD. Parameters such as chlorine, suspended solids and pH are monitored under the NPDES permit. Toledo Edison personnel prepare the NPDES Reports and submit them to the OEPA of each month.

Davis-Besse has six sampling points described in the NPDES permit. Five of these locations are discharge points, or *outfalls,* and one is a temperature monitoring location. Descriptions of these sampling points follow:

Outfall 001

Collection Box: At a point representative of discharge to Lake Erie.
Source of Wastes: Low volume wastes (Outfalls 601 and 602), circulation system blowdown and service water.

Outfall 002

Area Runoff: Discharge to Toussaint River
Source of Wastes: Storm water runoff, circulating pump house sumps.

Outfall 003

Screenwash Catch Basin: Outfall to Navarre Marsh.
Source Of Wastes: Wash debris from water intake screens.

Outfall 601

Wastewater Plant Tertiary Treatment Basin: Discharge from wastewater treatment system.
Sources Of Wastes: Wastewater Treatment Facility.

Outfall 602

Low volume wastes: Discharge from settling basins.
Sources of wastes: Water treatment residues, condensate polishing holdup tank decant, and condensate pit sumps.

Sampling Point 801

Intake Temperature: Intake water prior to cooling operation.

1999 NPDES Summary

During 1996, the NPDES permit was renewed by the Ohio EPA. This permit will expire on October 31, 2000, and a renewal application must be submitted by May of 2000. A new sampling requirement with outfall designation 004 will be added to the permit renewal application. This will be used to monitor the water drained from the Circulating Water System into the two ponds adjacent to the Cooling Tower during outages. There were no violations of the NPDES permit during 1999.

Chemical Waste Management

The Chemical Waste Management Program for hazardous and nonhazardous chemical wastes generated at the Davis-Besse Nuclear Power Station was developed to ensure wastes are managed and disposed of in accordance with all applicable state and federal regulations.

Waste Management

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) is the statute which regulates solid hazardous waste. Solid waste is defined as a solid, liquid, semisolid, or contained gaseous material. The major goals of RCRA are to establish a hazardous waste regulatory program to protect human health and the environment and to encourage the establishment of solid waste management, resource recovery, and resource conservation systems. The intent of the hazardous waste management program is to control hazardous wastes from the time they are generated until they are properly disposed of, commonly referred to as "cradle to grave" management. Anyone who generates, transports, stores, treats, or disposes of hazardous waste are subject to regulation under RCRA.

Under RCRA, there are essentially three categories of waste generators:

- Large quantity Generators - A facility which generates 1000 kilograms/month (2200 lbs month) or more.
- Small quantity Generators - A facility which generates less than 1000 kilograms/ month (2200 lbs/month).
- Conditionally Exempt Small Quantity Generators - A facility which generates 100 kilograms/month (220 lbs/month).

In 1999, the Davis-Besse Nuclear Power Station maintained small quantity generator status, generating 6,250 pounds of hazardous waste. Davis-Besse personnel also continuously strive to identify alternate ways to reduce hazardous waste generation.

Nonhazardous waste generated from standard operating sources included 3,000 gallons of used oils and 550 gallons of oil filters and solid oily debris. Other nonhazardous regulated waste generated included 310 gallons of other chemicals such as microfilm process chemicals and polystyrene resins.

RCRA also mandates other requirements such as the use of proper storage and shipping containers, labels, manifests, reports, personnel training, spill control plan and an accident contingency plan, all of which are part of the Chemical Management Program at Davis-Besse. The following are completed as part of the hazardous waste management program to ensure compliance with the RCRA regulations.

Inspections

- Chemical Waste Accumulation Areas are designated throughout the site to ensure proper handling and disposal of chemical waste. These, along with the Chemical Waste Storage Area, are routinely patrolled by security personnel and inspected weekly by Toledo Edison personnel. All areas used for storage or accumulation of hazardous waste are posted as such with warning signs, and drums are color-coded for easy identification of waste categories by Davis-Besse employees.

- **Waste Inventory Forms**

  Inventory forms are placed on waste accumulation drums or provided in the accumulation area to allow employees to record the waste type and amount as it is added to the drum. This ensures that incompatible wastes are not mixed and also identifies the drum contents for proper disposal.

Emergency Response Planning

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, sometimes referred to as Superfund) established a federal authority and source of funding for responding to spills and other releases of hazardous materials, pollutants, and contaminants into the environment. Superfund establishes "reportable quantities" for several hundred hazardous materials, and regulates the cleanup of abandoned hazardous waste disposal sites.

Superfund Amendment and Reauthorization Act (SARA)

Superfund was amended in October 1986, to establish new reporting programs dealing with emergency preparedness and community right-to-know laws. As part of this program, CERCLA is enhanced by ensuring that the potential for release of hazardous substances is minimized and adequate and timely responses are made to protect surrounding populations.

Davis-Besse conducts site-wide inspections to identify and record all hazardous products and chemicals onsite as required by SARA. Determinations were made as to which products and chemicals were present in sufficient quantities to report.

Annual SARA reports are submitted to local fire departments, and local and state planning commissions by March 1 for the preceding calendar year. No additional chemical products were identified for calendar year 1999.

Spill Kits

Spill control equipment is maintained throughout the Station at chemical storage areas and at appropriate hazardous chemical and oil use points. Equipment in the kits may include such items as chemical resistant coveralls, gloves, boots, decontamination agents, absorbent cloth, goggles, and warning signs.

Other Regulating Acts

Toxic Substances Control Act (TSCA)

The Toxic Substance Control Act (TSCA) was enacted to provide the USEPA with the authority to require testing of new chemical substances for potential health effects before they are introduced into the environment, and to regulate them where necessary. This law would have little impact on utilities except for the fact that one family of chemicals, polychlorinated biphenyls (PCBs), has been singled out by TSCA. This has resulted in an extensive PCB management system, very similar to the hazardous waste management system established under RCRA.

In 1992, Davis-Besse completed an aggressive program that eliminated PCB transformers onsite. PCB transformers were either changed out with non-PCB fluid transformers or retrofilled with non-PCB liquid.

Retrofilling PCB transformers involves flushing the PCB fluid out of a transformer, refilling it with PCB-leaching solvents and allowing the solvent to circulate in the transformer during operation. The entire retrofill process takes several years and will extract almost all of the PCB. In all, Davis-Besse performed retrofill activities on eleven PCB transformers between 1987 and 1992. The only remaining PCB containing equipment onsite are a limited number of capacitors. These capacitors are being replaced and disposed of during scheduled maintenance activities.

Clean Air Act

The Clean Air Act identifies substances which are considered air pollutants. Davis-Besse holds an OEPA permit to operate an Air Contaminant Source for the station auxiliary boiler. This boiler is used to heat the station and provide steam to plant systems when the reactor is not operating. A report detailing auxiliary boiler operation is submitted annually.

Applications for Permits to Operate an Air Pollution Source were submitted to the Ohio EPA for our six emergency diesel engines, including the Station Blackout Diesel Generator, the 2 Emergency Diesel Generators, the Emergency Response Facility Diesel, the Miscellaneous Diesel, and the Fire Pump Diesel. These sources are operated infrequently to verify their reliability, and would only be used in the event of an emergency.

In response to recent "Clean Air Act Title V" legislation, an independent study identifying and quantifying all of the air pollution sources onsite was performed. Of particular significance is asbestos removal from renovation and demolition projects for which USEPA has outlined specific regulations concerning handling, removal, environmental protection, and disposal. Also the Occupational Safety and Health Protection Administration (OSHA) strictly regulates asbestos with a concern for worker protection. Removal teams must meet medical surveillance, respirator fit tests, and training requirements prior to removing asbestos-containing material. Asbestos is not considered a hazardous waste by RCRA, but the EPA does require special handling and disposal of this waste under the Clean Air Act.

Transportation Safety Act

The transportation of hazardous chemicals, including chemical waste, is regulated by the Transportation Safety Act of 1976. These regulations are enforced by the United States Department of Transportation (DOT) and cover all aspects of transporting hazardous materials, including packing, handling, labeling, marking, and placarding. Before any wastes are transported off site, Davis-Besse must ensure that the wastes are identified, labeled and marked according to DOT regulations, including verification that the vehicle has appropriate placards and it is in good operating condition.

Other Programs

Underground Storage Tanks

According to RCRA, facilities with Underground Storage Tanks (UST) are required to notify the State. This regulation was implemented in order to provided protection from tank contents leaking and causing damage to the environment. Additional standards require leak detection systems and performance standards for new tanks. At Davis-Besse two 40,000 gallon and one 8,000 gallon diesel fuel storage tanks are registered USTs.

Waste Minimization and Recycling

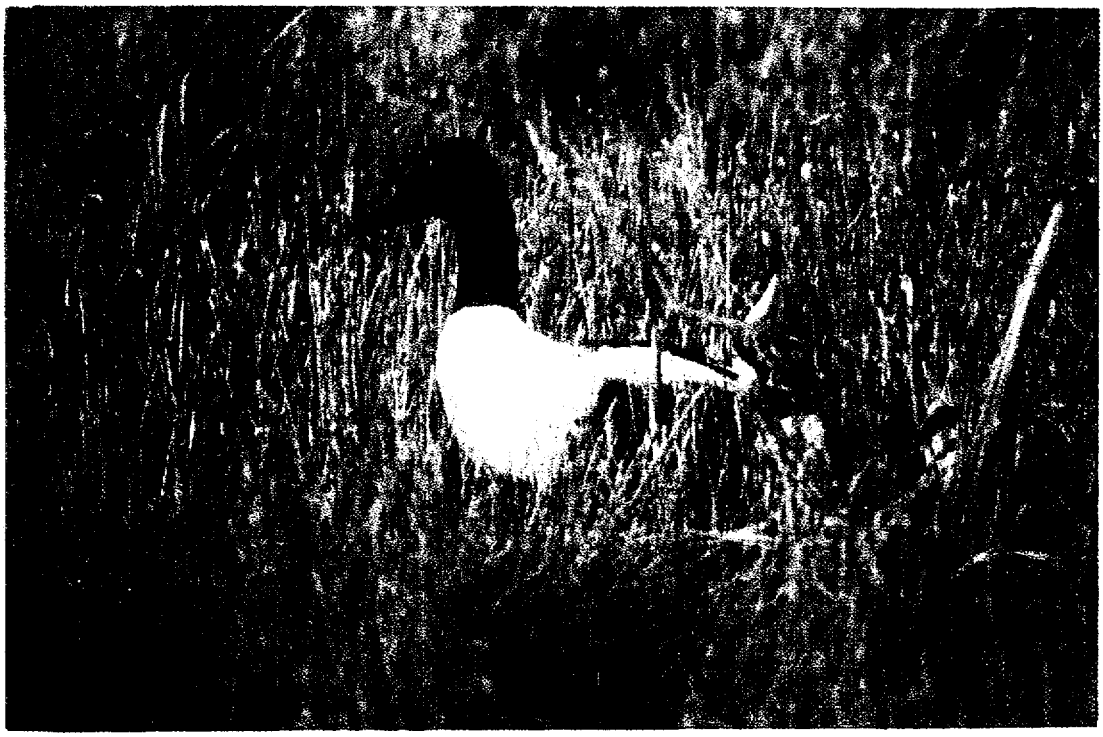
Municipal Solid Waste (MSW) is everyday trash which is produced by individuals at home and by industries. In some communities MSW is burned in specially designed incinerators to produce power or separated into waste types (such as aluminum, glass, and paper) and recycled. But the vast majority of MSW is sent to landfills for disposal. As the population increases and older landfills reach their capacity and close, MSW disposal becomes an important economic, health, and resource issue.

The State of Ohio has addressed the issue with the State Solid Waste Management Plan, otherwise known as Ohio House Bill 592. The intent of the bill is to extend the life of existing landfills by reducing the amount of MSW produced, by reusing waste material where possible and recycling of other waste materials. This is frequently referred to as **"Reduce, Reuse,** and **Recycle."**

Davis-Besse has implemented and participated in company wide programs which emphasize the reduce, reuse, recycle approach to MSW management. Improved efficiency in collection and hauling, resulted in a two year reduction of approximately 71 percent for disposal cost. Additionally, joint partnership agreements with yard waste compositors have been developed for yard and lawn waste recycling.

An active Investment Recovery Program has greatly contributed to the reduction of both hazardous and municipal waste generated by evaluating options for uses of surplus materials prior to the materials entering Davis-Besse's waste streams. Such programs include paper, cardboard, aluminum cans, used tires, and metals recycling or recovery. Paper and cardboard recycling typically

exceeds 50 tons annually. This represents a large volume of recyclable resources which would have otherwise been placed in a landfill. Aluminum soft drink cans are collected on site for the Boy Scouts to recycle. Additionally, lead-acid batteries are recycled and tires are returned to the seller for proper disposal. Although scrap metal is not usually considered part of the MSW stream, Davis-Besse does collect and recycle scrap metals. The metals are sold at current market price to a scrap dealer for resource recovery. These programs are continuously being expanded and reinforced as other components of MSW stream are targeted for reduction.



Appendices

APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Teledyne Brown Engineering - Environmental Services, Midwest Laboratory participates in intercomparison studies administered by Environmental Resources Associates, and serves as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. Results are reported in Appendix A. TLD Intercomparison results, in-house spikes, blanks, duplicates and mixed analyte performance evaluation program results are also reported. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only.

January, 1999 through December, 1999

Appendix A

Interlaboratory Comparison Program Results

Teledyne Brown Engineering Environmental Services Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's quality control program in December 1971. These programs are operated by agencies which supply environmental type samples (e.g., milk or water) containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water and air filters during the past twelve months. Data for previous years is available upon request.

This program was conducted by Environmental Resources Associates and serves to replace studies conducted by the U.S. Environmental Protection Agency.

The results in Table A-2 were obtained for Thermoluminescent Dosimeters (TLDs), via various International Intercomparisons of Environmental Dosimeters under the sponsorships listed in Table A-2. Also Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house "spiked" samples for the past twelve months. All samples are prepared using NIST traceable sources. Data for previous years available upon request.

Table A-4 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-5 list results of the in-house "duplicate" program for the past twelve months. Acceptance is based on the difference of the results being less than the sum of the errors. Data for previous years available upon request.

The results in Table A-6 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

The results in Table A-7 were obtained through participation in the Environmental Measurement Laboratory Quality Assessment Program.

Attachment A lists acceptance criteria for "spiked" samples.

Out-of-limit results are explained directly below the result.

12-31-99

ATTACHMENT A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES[a]

Analysis	Level	One Standard Deviation for single determinations
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg >30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium-40	>0.1 g/liter or kg	5% of known value
Gross alpha	≤20 pCi/liter >20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤100 pCi/liter >100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤4,000 pCi/liter >4,000 pCi/liter	1s = (pCi/liter) = $169.85 \times (\text{known})^{0.0933}$ 10% of known value
Radium-226,-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	≤55 pCi/liter >55 pCi/liter	6.0 pCi/liter 10% of known value
Uranium-238, Nickel-63[b] Technetium-99[b]	≤35 pCi/liter >35 pCi/liter	6.0 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value
Others[b]	–	20% of known value

[a] From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year, 1981-1982, EPA-600/4-81-004.

[b] Teledyne limit.

Table A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA), comparison of ERA and Teledyne Midwest Laboratory results[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	ERA Result[d] 1s, N=1	Control Limits
STW-861	WATER	Sep, 1999	Ra-226	15.6 ± 0.3	16.5 ± 1.7	12.2 - 20.8
STW-861	WATER	Sep, 1999	Ra-228	3.2 ± 0.3	2.2 ± 0.2	1.2 - 3.1
The activity reported is the average of three separate analyses. Individual results : 2.6, 2.9 and 4.0.						
STW-861	WATER	Sep, 1999	Uranium	39.4 ± 1.2	45.4 ± 4.5	37.7 - 53.1
STW-862	WATER	Nov, 1999	I-131	23.9 ± 0.1	23.3 ± 2.3	18.1 - 28.5

[a] Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the environmental sample crosscheck program operated by Environmental Resource Associates(ERA).

[b] All results are in pCi/L, except for elemental potassium (K) data in milk, which are in mg/L; air filter samples, which are in pCi/Filter.

[c] Unless otherwise indicated, the TBEESML results are given as the mean ± 2 standard deviations for three determinations.

[d] ERA results are presented as the known values and expected laboratory precision (1s, 1 determination) and control limits as defined by ERA.

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value	Average ± 2 Sigma (All Participants)
Teledyne Testing						
98-1	LiF-100 Chips	May, 1998	Lab, 1	15.5 ± 1.3	16.7	-
98-1	LiF-100 Chips	May, 1998	Lab, 2	23.9 ± 0.9	32.4	-
98-1	LiF-100 Chips	May, 1998	Lab, 3	59.8 ± 1.9	60.2	-
98-1	$CaSO_4$: Dy Cards	May, 1998	Reader 1, #1	18.5 ± 0.8	16.7	-
98-1	$CaSO_4$: Dy Cards	May, 1998	Reader 1, #2	27.3 ± 1.7	32.4	-
98-1	$CaSO_4$: Dy Cards	May, 1998	Reader 1, #3	70.0 ± 4.7	60.2	-
Chips and Cards were irradiated by Teledyne Brown Engineering, Westwood, New Jersey, in May, 1998.						
Teledyne Testing						
99-1	LiF-100 Chips	Mar, 1999	Lab, 1	14.5 ± 0.5	15.4	-
99-1	LiF-100 Chips	Mar, 1999	Lab, 2	29.3 ± 1.0	31.8	-
99-1	LiF-100 Chips	Mar, 1999	Lab, 3	60.0 ± 0.2	59.1	-
99-1	$CaSO_4$: Dy Cards	Mar, 1999	Reader 1, #1	18.3 ± 0.5	15.4	-
99-1	$CaSO_4$: Dy Cards	Mar, 1999	Reader 1, #2	35.9 ± 1.3	31.8	-
99-1	$CaSO_4$: Dy Cards	Mar, 1999	Reader 1, #3	66.5 ± 4.4	59.1	-
Chips and Cards were irradiated by Teledyne Brown Engineering, Westwood, New Jersey, in March, 1999.						

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-140	WATER	Jan, 1999	Ra-226	14.51 ± 0.52	13.79	9.65 - 17.93
SPW-140	WATER	Jan, 1999	Ra-228	9.47 ± 1.49	8.28	5.80 - 10.76
SPW-142	WATER	Jan, 1999	Gr. Alpha	30.82 ± 2.49	33.97	16.99 - 50.96
SPW-142	WATER	Jan, 1999	Gr. Beta	30.87 ± 1.91	30.18	20.18 - 40.18
SPW-254	WATER	Jan, 1999	H-3	37752.00 ± 540.00	38559.00	30847.20 - 46270.80
SPAP-270	AIR FILTER	Jan, 1999	Cs-137	2.04 ± 0.02	1.82	1.09 - 2.55
SPAP-787	AIR FILTER	Jan, 1999	Gr. Beta	5.97 ± 0.02	5.38	0.00 - 15.38
SPW-789	WATER	Jan, 1999	Co-60	44.83 ± 7.11	40.46	30.46 - 50.46
SPW-789	WATER	Jan, 1999	Cs-137	45.17 ± 8.63	37.70	27.70 - 47.70
SPW-791	WATER	Feb, 1999	Ra-226	15.50 ± 0.60	13.80	9.66 - 17.94
SPW-791	WATER	Feb, 1999	Ra-228	6.36 ± 1.39	8.20	5.74 - 10.66
SPW-792	WATER	Feb, 1999	Gr. Alpha	24.36 ± 2.08	33.97	16.99 - 50.96
SPW-792	WATER	Feb, 1999	Gr. Beta	28.98 ± 1.79	30.13	20.13 - 40.13
SPU-1030	WATER	Feb, 1999	Ra-226	38.81 ± 1.30	34.45	24.12 - 44.79
SPW-1460	WATER	Mar, 1999	Ra-226	13.26 ± 0.55	13.79	9.65 - 17.93
SPW-1460	WATER	Mar, 1999	Ra-228	12.53 ± 1.47	16.26	11.38 - 21.13
SPW-1466	WATER	Mar, 1999	Gr. Alpha	61.00 ± 3.08	49.44	24.72 - 74.15
SPW-1466	WATER	Mar, 1999	Gr. Beta	35.52 ± 1.86	30.07	20.07 - 40.07
SPMI-1677	MILK	Mar, 1999	Cs-137	17.17 ± 2.08	18.78	8.78 - 28.78
SPMI-1677	MILK	Mar, 1999	Sr-90	34.94 ± 1.53	31.85	25.48 - 38.22
SPW-1681	WATER	Mar, 1999	Sr-89	49.30 ± 3.85	59.20	47.36 - 71.04
SPW-1681	WATER	Mar, 1999	Sr-90	29.00 ± 1.65	31.85	25.48 - 38.22
SPW-2264	WATER	Apr, 1999	Ra-226	12.44 ± 0.14	13.80	9.66 - 17.94
SPW-2264	WATER	Apr, 1999	Ra-228	18.73 ± 1.92	16.08	11.26 - 20.90
SPAP-2395	AIR FILTER	Apr, 1999	Cs-137	1.86 ± 0.02	1.81	1.09 - 2.53
SPW-2265	WATER	Apr, 1999	Gr. Alpha	62.89 ± 5.90	49.40	24.70 - 74.10
SPW-2265	WATER	Apr, 1999	Gr. Beta	34.52 ± 3.24	30.00	20.00 - 40.00
SPW-2574	WATER	Apr, 1999	H-3	56548.00 ± 648.00	57517.00	46013.60 - 69020.40
SPMI-2686	MILK	Apr, 1999	Cs-134	23.56 ± 5.30	22.30	12.30 - 32.30
SPMI-2686	MILK	Apr, 1999	Cs-137	40.21 ± 7.19	37.50	27.50 - 47.50
SPW-2688	WATER	Apr, 1999	Co-60	20.79 ± 5.61	19.64	9.64 - 29.64
SPW-2688	WATER	Apr, 1999	Cs-134	23.16 ± 6.13	22.29	12.29 - 32.29
SPW-2688	WATER	Apr, 1999	Cs-137	37.49 ± 3.75	31.60	21.60 - 41.60
SPAP-2653	AIR FILTER	Apr, 1999	Gr. Beta	8.96 ± 0.05	8.19	0.00 - 18.19
SPVE-2977	VEGETATION	May, 1999	Cs-134	0.67 ± 0.04	0.68	0.41 - 0.95
SPVE-2977	VEGETATION	May, 1999	Cs-137	0.55 ± 0.05	0.58	0.35 - 0.81
SPW-3314	WATER	May, 1999	Ra-226	13.62 ± 0.35	13.79	9.65 - 17.93
SPW-3314	WATER	May, 1999	Ra-228	16.57 ± 1.73	15.93	11.15 - 20.71
SPSO-3317	SOIL	May, 1999	Cs-134	0.09 ± 0.01	0.07	0.04 - 0.10
SPSO-3317	SOIL	May, 1999	Cs-137	0.54 ± 0.05	0.42	0.25 - 0.59
SPSO-3318	SOIL	May, 1999	Cs-134	0.09 ± 0.02	0.07	0.04 - 0.10

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPSO-3318	SOIL	May, 1999	Cs-137	0.54 ± 0.02	0.42	0.25 - 0.59
SPW-3315	WATER	May, 1999	Gr. Beta	32.57 ± 1.63	29.95	19.95 - 39.95
SPF-3777	FISH	May, 1999	Cs-134	0.43 ± 0.03	0.52	0.31 - 0.73
SPF-3777	FISH	May, 1999	Cs-137	0.57 ± 0.04	0.60	0.36 - 0.84
SPW-3721	WATER	Jun, 1999	Rn-222	553.52 ± 46.70	610.35	366.21 - 854.49
SPW-4005	WATER	Jun, 1999	Ra-226	13.85 ± 0.42	13.79	9.65 - 17.93
SPW-4005	WATER	Jun, 1999	Ra-228	16.42 ± 1.81	15.77	11.04 - 20.50
SPW-4006	WATER	Jun, 1999	Gr. Alpha	46.32 ± 2.80	49.41	24.71 - 74.12
SPW-4006	WATER	Jun, 1999	Gr. Beta	32.12 ± 1.83	29.90	19.90 - 39.90
SPW-4869	WATER	Jul, 1999	Ra-226	14.00 ± 0.47	13.79	9.65 - 17.93
SPW-4869	WATER	Jul, 1999	Ra-228	14.96 ± 1.53	15.62	10.93 - 20.31
SPW-4870	WATER	Jul, 1999	Gr. Alpha	70.07 ± 3.45	29.84	14.92 - 44.76
SPW-4870	WATER	Jul, 1999	Gr. Beta	84.01 ± 2.62	41.18	31.18 - 51.18
Results for gross alpha and beta appear to be approximately 2x the spike level. The sample volume or spike level is suspect.						
SPW-4964	WATER	Jul, 1999	H-3	60442.00 ± 679.00	56807.00	45445.60 - 68168.40
SPAP-5001	AIR FILTER	Jul, 1999	Cs-137	2.03 ± 0.02	1.79	1.07 - 2.51
SPAP-5003	AIR FILTER	Jul, 1999	Gr. Beta	7.48 ± 0.02	8.15	0.00 - 18.15
SPMI-5348	MILK	Jul, 1999	Sr-89	46.85 ± 4.96	55.53	44.42 - 66.64
SPMI-5348	MILK	Jul, 1999	Sr-90	31.47 ± 1.65	31.60	25.28 - 37.92
SPW-5502	WATER	Jul, 1999	Sr-89	43.27 ± 2.81	51.15	40.92 - 61.38
SPW-5502	WATER	Jul, 1999	Sr-90	31.80 ± 1.56	31.59	25.27 - 37.91
SPF-5676	FISH	Jul, 1999	Cs-134	0.67 ± 0.04	0.65	0.39 - 0.91
SPF-5676	FISH	Jul, 1999	Cs-137	0.63 ± 0.05	0.60	0.36 - 0.83
SPCH-5833	CHARCOAL CANISTER	Aug, 1999	I-131(g)	1.46 ± 0.06	1.40	0.84 - 1.96
SPVE-5826	VEGETATION	Aug, 1999	I-131(g)	1.43 ± 0.09	1.25	0.75 - 1.75
SPMI-5828	MILK	Aug, 1999	Cs-134	31.46 ± 5.05	30.23	20.23 - 40.23
SPMI-5828	MILK	Aug, 1999	Cs-137	39.22 ± 7.60	37.23	27.23 - 47.23
SPMI-5828	MILK	Aug, 1999	I-131	72.33 ± 1.06	79.17	63.34 - 95.00
SPMI-5828	MILK	Aug, 1999	I-131(g)	77.99 ± 8.12	79.17	47.50 - 89.17
SPW-5830	WATER	Aug, 1999	Ra-226	13.82 ± 0.34	13.79	9.65 - 17.93
SPW-5830	WATER	Aug, 1999	Ra-228	13.59 ± 1.80	15.46	10.82 - 20.10
SPW-5831	WATER	Aug, 1999	Gr. Alpha	46.05 ± 2.93	41.17	20.59 - 61.76
SPW-5831	WATER	Aug, 1999	Gr. Beta	35.66 ± 2.01	29.78	19.78 - 39.78
SPW-6076	WATER	Aug, 1999	I-131	83.72 ± 0.98	99.30	79.44 - 119.16
SPW-6076	WATER	Aug, 1999	I-131(g)	105.38 ± 18.30	99.30	59.58 - 109.30
SPW-6542	WATER	Sep, 1999	Ra-226	15.38 ± 0.52	13.79	9.65 - 17.93
SPW-6542	WATER	Sep, 1999	Ra-228	16.48 ± 2.25	15.46	10.82 - 20.10
SPW-6543	WATER	Sep, 1999	Gr. Alpha	47.77 ± 2.69	41.17	20.59 - 61.76
SPW-6543	WATER	Sep, 1999	Gr. Beta	35.25 ± 1.86	29.78	19.78 - 39.78
SPW-7468	WATER	Oct, 1999	Ra-226	14.36 ± 0.41	13.79	9.65 - 17.93

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[a] Teledyne Results 2s, n=1[b]	Known Activity	Control[c] Limits
SPW-7468	WATER	Oct, 1999	Ra-228	13.41 ± 1.45	15.16	10.61 - 19.71
SPW-7469	WATER	Oct, 1999	Gr. Beta	31.37 ± 3.16	29.68	19.68 - 39.68
SPW-7486	WATER	Oct, 1999	I-131	49.26 ± 0.89	48.82	36.82 - 60.82
SPMI-7488	MILK	Oct, 1999	I-131	49.54 ± 0.89	48.82	36.82 - 60.82
SPSO-7761	SOIL	Oct, 1999	Cs-134	0.06 ± 0.01	0.07	0.04 - 0.10
SPSO-7761	SOIL	Oct, 1999	Cs-137	0.53 ± 0.01	0.49	0.29 - 0.69
SPAP-7763	AIR FILTER	Oct, 1999	Cs-137	1.84 ± 0.02	1.79	1.07 - 2.51
SPW-7469	WATER	Oct, 1999	Gr. Alpha	43.55 ± 4.67	41.16	20.58 - 61.74
SPF-8545	FISH	Oct, 1999	Cs-134	0.60 ± 0.03	0.59	0.36 - 0.83
SPF-8545	FISH	Oct, 1999	Cs-137	0.60 ± 0.04	0.59	0.36 - 0.83
SPMI-9028	MILK	Oct, 1999	Cs-134	39.43 ± 6.37	37.43	27.43 - 47.43
SPMI-9028	MILK	Oct, 1999	Cs-137	40.93 ± 9.42	37.05	27.05 - 47.05
SPW-8773	WATER	Nov, 1999	Ra-226	11.30 ± 0.14	13.79	9.65 - 17.93
SPW-8773	WATER	Nov, 1999	Ra-228	15.18 ± 2.26	15.00	10.50 - 19.50
SPW-8774	WATER	Nov, 1999	Gr. Alpha	43.12 ± 3.09	41.15	20.58 - 61.73
SPW-8774	WATER	Nov, 1999	Gr. Beta	31.98 ± 2.06	29.62	19.62 - 39.62
SPW-9133	WATER	Nov, 1999	Co-60	30.70 ± 4.43	29.06	19.06 - 39.06
SPW-9133	WATER	Nov, 1999	Cs-134	40.56 ± 4.53	36.59	26.59 - 46.59
SPW-9133	WATER	Nov, 1999	Cs-137	38.20 ± 6.14	36.98	26.98 - 46.98
SPW-9720	WATER	Nov, 1999	H-3	57335.00 ± 657.00	58177.00	46541.60 - 69812.40
SPW-9717	WATER	Dec, 1999	Ra-228	18.88 ± 1.80	14.80	10.36 - 19.24
SPW-9719	WATER	Dec, 1999	Ra-226	14.91 ± 0.48	13.79	9.65 - 17.93
SPCH-9806	CHARCOAL CANISTER	Dec, 1999	I-131(g)	0.06 ± 0.01	0.06	0.04 - 0.09
SPW-9718	WATER	Dec, 1999	Gr. Alpha	44.82 ± 2.39	44.81	22.41 - 67.22
SPW-9718	WATER	Dec, 1999	Gr. Beta	33.93 ± 1.72	29.54	19.54 - 39.54
SPW-9718	WATER	Dec, 1999	Gr. Beta	33.93 ± 1.72	29.54	19.54 - 39.54

[a] All results are in pCi/L, except for elemental potassium (K) in milk, which are in mg/L.; air filter samples, which are in pCi/Filter; and food products, which are in mg/kg.
[b] All samples are the results of single determinations.
[c] Control limits are based on Attachment A, page A2 of this report.

NOTE: For fish, Jello is used for the spike matrix. For vegetation, Sawdust is used for the spike matrix.

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Teledyne Results (4.66 Sigma) Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-141	WATER	Jan 1999	Gr. Alpha	< 0.470	0.207 ± 0.320	< 1.00
SPW-141	WATER	Jan 1999	Gr. Beta	< 0.890	0.234 ± 0.591	< 3.20
SPW-141	WATER	Jan 1999	Ra-226	< 0.064	0.054 ± 0.030	< 1.00
SPW-141	WATER	Jan 1999	Ra-228	< 1.000	0.460 ± 0.530	< 1.00
SPW-255	WATER	Jan 1999	H-3	< 178.000	23.455 ± 94.510	< 200.00
SPW-790	WATER	Feb 1999	Gr. Alpha	< 0.440	-0.130 ± 0.250	< 1.00
SPW-790	WATER	Feb 1999	Gr. Beta	< 1.010	-0.250 ± 0.610	< 3.20
SPW-790	WATER	Feb 1999	Ra-226	< 0.036	0.026 ± 0.017	< 1.00
SPW-790	WATER	Feb 1999	Ra-228	< 0.850	0.355 ± 0.440	< 1.00
SPW-1461	WATER	Mar 1999	Gr. Alpha	< 0.800	0.060 ± 0.540	< 1.00
SPW-1461	WATER	Mar 1999	Gr. Beta	< 1.600	0.460 ± 1.080	< 3.20
SPW-1461	WATER	Mar 1999	Ra-226	< 0.044	0.071 ± 0.028	< 1.00
SPW-1461	WATER	Mar 1999	Ra-228	< 0.700	0.280 ± 0.350	< 1.00
SPMI-1678	MILK	Mar 1999	Sr-89	< 0.590	-0.190 ± 0.670	< 5.00
SPMI-1678	MILK	Mar 1999	Sr-90		1.020 ± 0.360	< 1.00
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPW-1682	WATER	Mar 1999	Sr-89	< 0.530	-0.310 ± 0.450	< 5.00
SPW-1682	WATER	Mar 1999	Sr-90	< 0.590	0.256 ± 0.307	< 1.00
SPW-2263	WATER	Apr 1999	Gr. Alpha	< 0.380	-0.160 ± 0.240	< 1.00
SPW-2263	WATER	Apr 1999	Gr. Beta	< 0.880	0.320 ± 0.580	< 3.20
SPW-2263	WATER	Apr 1999	Ra-226	< 0.013	0.023 ± 0.009	< 1.00
SPW-2263	WATER	Apr 1999	Ra-228	< 0.680	0.310 ± 0.360	< 1.00
SPW-2575	WATER	Apr 1999	H-3	< 158.000	23.150 ± 79.380	< 200.00
SPAP-2652	AIR FILTER	Apr 1999	Gr. Beta	< 0.003	-0.000 ± 0.001	< 3.20
SPW-3316	WATER	May 1999	Ra-226	< 0.027	0.030 ± 0.014	< 1.00
SPW-3316	WATER	May 1999	Ra-228	< 0.800	0.192 ± 0.397	< 1.00
SPW-3316	WATER	May 1999	Gr. Alpha	< 0.830	0.310 ± 0.600	< 1.00
SPW-3316	WATER	May 1999	Gr. Beta	< 1.580	0.220 ± 1.110	< 3.20
SPW-4004	WATER	Jun 1999	Gr. Alpha	< 0.870	-0.030 ± 0.570	< 1.00
SPW-4004	WATER	Jun 1999	Gr. Beta	< 1.740	0.470 ± 1.150	< 3.20
SPW-4004	WATER	Jun 1999	Ra-226	< 0.023	0.036 ± 0.014	< 1.00
SPW-4004	WATER	Jun 1999	Ra-228	< 0.990	0.770 ± 0.551	< 1.00
SPW-4871	WATER	Jul 1999	Gr. Alpha	< 0.660	-0.420 ± 0.470	< 1.00
SPW-4871	WATER	Jul 1999	Gr. Beta	< 1.420	0.400 ± 1.060	< 3.20
SPW-4871	WATER	Jul 1999	Ra-226	< 0.019	0.021 ± 0.013	< 1.00
SPW-4871	WATER	Jul 1999	Ra-228	< 0.620	0.610 ± 0.360	< 1.00

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L[a]. Teledyne Results (4.66 Sigma) LLD	Teledyne Results (4.66 Sigma) Activity[b]	Acceptance Criteria (4.66 Sigma)
SPW-4965	WATER	Jul 1999	H-3	< 176.000	8.100 ± 87.800	< 200.00
SPMI-5349	MILK	Jul 1999	Sr-89	< 0.410	-0.750 ± 0.540	< 5.00
SPMI-5349	MILK	Jul 1999	Sr-90		1.140 ± 0.360	< 1.00
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPW-5501	WATER	Jul 1999	Sr-89	< 0.450	0.150 ± 0.450	< 5.00
SPW-5501	WATER	Jul 1999	Sr-90	< 0.580	0.280 ± 0.310	< 1.00
SPMI-5829	MILK	Aug 1999	I-131	< 0.240	0.140 ± 0.140	< 0.50
SPW-5832	WATER	Aug 1999	Gr. Alpha	< 0.890	0.570 ± 0.600	< 1.00
SPW-5832	WATER	Aug 1999	Gr. Beta	< 2.000	0.590 ± 1.230	< 3.20
SPW-5832	WATER	Aug 1999	Ra-226	< 0.020	0.090 ± 0.010	< 1.00
SPW-5832	WATER	Aug 1999	Ra-228	< 0.780	0.110 ± 0.370	< 1.00
SPW-6067	WATER	Aug 1999	I-131	< 0.250	0.017 ± 0.170	< 0.50
SPW-6541	WATER	Sep 1999	Gr. Alpha	< 0.770	0.360 ± 0.530	< 1.00
SPW-6541	WATER	Sep 1999	Gr. Beta	< 1.690	0.410 ± 1.130	< 3.20
SPW-6541	WATER	Sep 1999	Ra-226	< 0.020	0.160 ± 0.020	< 1.00
SPW-6541	WATER	Sep 1999	Ra-228	< 1.280	0.018 ± 0.594	< 1.00
SPW-7467	WATER	Oct 1999	Ra-226		0.069 ± 0.014	< 1.00
SPW-7467	WATER	Oct 1999	Ra-228	< 0.892	0.461 ± 0.467	< 1.00
SPW-7487	WATER	Oct 1999	I-131	< 0.260	0.080 ± 0.150	< 0.50
SPMI-7489	MILK	Oct 1999	I-131	< 0.250	0.140 ± 0.150	< 0.50
SPW-8775	WATER	Nov 1999	Ra-226		0.050 ± 0.012	< 1.00
SPW-8775	WATER	Nov 1999	Ra-228	< 0.989	0.380 ± 0.500	< 1.00
SPW-9721	WATER	Nov 1999	H-3	< 158.000	51.400 ± 80.600	< 200.00
SPW-9719	WATER	Dec 1999	Ra-226		0.031 ± 0.013	< 1.00

[a] Liquid sample results are reported in pCi/Liter, air filter sample results are in pCi/filter, charcoal sample results are in pCi/charcoal, and solid sample results are in pCi/kilogram.
[b] The activity reported is the net activity result.

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
E-47, 48	Jan, 1999	Gr. Beta	1.206 ± 0.056	1.265 ± 0.061	1.236 ± 0.041
E-47, 48	Jan, 1999	K-40	1.283 ± 0.136	1.394 ± 0.182	1.339 ± 0.114
SW-68, 69	Jan, 1999	K-40 (FP)	1.300 ± 0.130	1.300 ± 0.130	1.300 ± 0.092
LW-153, 154	Jan, 1999	Gr. Beta	1.509 ± 0.647	1.619 ± 0.646	1.564 ± 0.457
WW-373, 374	Jan, 1999	H-3	171.100 ± 83.600	131.700 ± 81.800	151.400 ± 58.481
SW-867, 868	Jan, 1999	H-3	1,149.300 ± 122.100	1,225.000 ± 124.400	1,187.150 ± 87.155
SWT-425, 426	Jan, 1999	Gr. Beta	2.572 ± 0.639	2.646 ± 0.598	2.609 ± 0.438
CW-450, 451	Jan, 1999	Gr. Beta	0.600 ± 1.100	0.700 ± 1.100	0.650 ± 0.778
SW-570, 571	Feb, 1999	K-40 (FP)	1.730 ± 0.173	1.644 ± 0.164	1.687 ± 0.119
LW-614, 615	Feb, 1999	Gr. Alpha	0.354 ± 0.369	0.666 ± 0.390	0.510 ± 0.268
LW-614, 615	Feb, 1999	Gr. Beta	2.213 ± 0.406	2.613 ± 0.442	2.413 ± 0.300
MI-682, 683	Feb, 1999	Co-60	0.200 ± 0.600	-0.400 ± 2.700	-0.100 ± 1.383
MI-682, 683	Feb, 1999	Cs-137	0.300 ± 3.700	0.600 ± 2.700	0.450 ± 2.290
MI-682, 683	Feb, 1999	I-131	0.200 ± 0.300	0.200 ± 0.300	0.200 ± 0.212
WW-968, 969	Feb, 1999	H-3	199.300 ± 89.600	80.900 ± 84.500	140.100 ± 61.580
CW-1042, 1043	Feb, 1999	Gr. Beta	3.200 ± 1.500	3.500 ± 1.530	3.350 ± 1.071
LW-1523, 1524	Feb, 1999	Gr. Beta	1.930 ± 0.567	2.197 ± 0.584	2.063 ± 0.407
MI-1627, 1628	Mar, 1999	K-40	1,340.200 ± 118.000	1,409.300 ± 112.000	1,374.750 ± 81.345
WW-1808, 1809	Mar, 1999	H-3	4.400 ± 83.400	47.400 ± 85.300	25.900 ± 59.648
LW-2937, 2938	Mar, 1999	Gr. Beta	3.044 ± 0.663	3.242 ± 0.660	3.143 ± 0.468
AP-2155, 2156	Mar, 1999	Be-7	0.078 ± 0.017	0.073 ± 0.015	0.075 ± 0.011
AP-2357, 2358	Mar, 1999	Be-7	0.081 ± 0.016	0.086 ± 0.020	0.084 ± 0.013
AP-1991, 1992	Mar, 1999	Be-7	0.218 ± 0.079	0.149 ± 0.062	0.184 ± 0.050
AP-1991, 1992	Mar, 1999	Be-7	0.083 ± 0.011	0.082 ± 0.015	0.083 ± 0.009
LW-2405, 2406	Mar, 1999	Gr. Beta	3.322 ± 0.473	2.292 ± 0.468	2.807 ± 0.333
LW-2474, 2475	Mar, 1999	Gr. Beta	2.003 ± 0.592	2.742 ± 0.648	2.372 ± 0.439
LW-2474, 2475	Mar, 1999	H-3	124.016 ± 84.129	151.507 ± 85.318	137.762 ± 59.910
MI-2019, 2020	Apr, 1999	K-40	1,277.300 ± 173.000	1,377.800 ± 107.000	1,327.550 ± 101.708
MI-2019, 2020	Apr, 1999	Sr-90	0.615 ± 0.366	1.126 ± 0.368	0.871 ± 0.260
WW-2040, 2041	Apr, 1999	Gr. Beta	1.424 ± 0.316	1.233 ± 0.329	1.329 ± 0.228
WW-2040, 2041	Apr, 1999	K-40 (FP)	1.100 ± 0.110	1.100 ± 0.110	1.100 ± 0.078
MI-2134, 2135	Apr, 1999	K-40	1,316.000 ± 147.000	1,485.100 ± 168.000	1,400.550 ± 111.617
AP-2658, 2659	Apr, 1999	Be-7	0.134 ± 0.067	0.175 ± 0.105	0.154 ± 0.062
MI-2019, 2020	Apr, 1999	Calcium	0.850 ± 0.085	0.880 ± 0.088	0.865 ± 0.061
MI-2251, 2252	Apr, 1999	K-40	1,261.900 ± 156.000	1,320.800 ± 141.000	1,291.350 ± 105.139

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-2451, 2452	Apr, 1999	K-40	1,647.700 ± 201.000	1,706.300 ± 159.000	1,677.000 ± 128.142
SS-2528, 2529	Apr, 1999	Gr. Beta	7.724 ± 1.978	9.287 ± 1.970	8.505 ± 1.396
SS-2528, 2529	Apr, 1999	K-40	7.530 ± 0.520	8.073 ± 0.388	7.802 ± 0.324
SS-2758, 2759	Apr, 1999	Gr. Beta	6.540 ± 2.200	4.960 ± 2.190	5.750 ± 1.552
SS-2758, 2759	Apr, 1999	K-40	7.483 ± 0.416	7.357 ± 0.432	7.420 ± 0.300
SS-2758, 2759	Apr, 1999	Sr-90	0.006 ± 0.008	-0.005 ± 0.007	0.000 ± 0.005
BS-3093, 3094	Apr, 1999	Gr. Beta	5.180 ± 1.350	5.960 ± 1.370	5.570 ± 0.962
F-3072, 3073	Apr, 1999	K-40	2.991 ± 0.332	2.438 ± 0.347	2.714 ± 0.240
MI-3001, 3002	Apr, 1999	K-40	1,485.800 ± 142.000	1,564.900 ± 162.000	1,525.350 ± 107.713
LW-3149, 3150	Apr, 1999	Gr. Beta	1.982 ± 0.595	2.120 ± 0.612	2.051 ± 0.427
SW-3047, 3048	May, 1999	Gr. Beta	2.281 ± 0.585	2.194 ± 0.567	2.238 ± 0.407
SW-3047, 3048	May, 1999	K-40 (FP)	1.300 ± 0.130	1.400 ± 0.140	1.350 ± 0.096
F-3238, 3239	May, 1999	Gr. Beta	3.329 ± 0.135	3.388 ± 0.144	3.358 ± 0.099
F-3238, 3239	May, 1999	K-40	2.866 ± 0.366	2.792 ± 0.337	2.829 ± 0.249
BS-3195, 3196	May, 1999	K-40	8.610 ± 0.620	9.320 ± 0.540	8.965 ± 0.411
AP-3769, 3770	May, 1999	Be-7	0.135 ± 0.075	0.188 ± 0.097	0.161 ± 0.061
MI-3259, 3260	May, 1999	K-40	1,444.800 ± 94.200	1,460.300 ± 166.000	1,452.550 ± 95.433
AP-3304, 3305	May, 1999	Be-7	0.104 ± 0.083	0.095 ± 0.068	0.099 ± 0.054
G-3461, 3462	May, 1999	Be-7	0.454 ± 0.210	0.350 ± 0.154	0.402 ± 0.130
G-3461, 3462	May, 1999	K-40	5.341 ± 0.492	4.837 ± 0.619	5.089 ± 0.395
SW-3217, 3218	May, 1999	Gr. Alpha	1.223 ± 1.323	2.490 ± 1.230	1.857 ± 0.903
SW-3217, 3218	May, 1999	Gr. Beta	4.956 ± 1.232	5.715 ± 1.221	5.336 ± 0.867
LW-2937, 2938	May, 1999	Gr. Beta	2.379 ± 0.626	2.864 ± 0.641	2.622 ± 0.448
SWU-2853, 2854	May, 1999	Gr. Beta	2.860 ± 0.539	3.065 ± 0.577	2.962 ± 0.395
DW-2878, 2879	May, 1999	Gr. Beta	0.706 ± 0.319	0.849 ± 0.335	0.777 ± 0.231
G-3461, 3462	May, 1999	Gr. Beta	5.205 ± 0.169	5.166 ± 0.110	5.186 ± 0.101
SO-3482, 3483	May, 1999	Cs-137	0.456 ± 0.059	0.467 ± 0.048	0.461 ± 0.038
SO-3482, 3483	May, 1999	Gr. Beta	24.880 ± 1.980	26.170 ± 2.150	25.525 ± 1.461
SO-3482, 3483	May, 1999	K-40	20.631 ± 1.240	20.077 ± 0.906	20.354 ± 0.768
SO-2832, 2833	May, 1999	Cs-137	0.390 ± 0.052	0.403 ± 0.031	0.397 ± 0.030
SO-2832, 2833	May, 1999	K-40	26.000 ± 0.660	24.673 ± 1.240	25.337 ± 0.702
SWT-3675, 3676	May, 1999	Gr. Beta	2.439 ± 0.598	2.530 ± 0.630	2.484 ± 0.434
LW-3699, 3700	May, 1999	Gr. Beta	2.488 ± 0.596	3.002 ± 0.654	2.745 ± 0.442
MI-3748, 3749	Jun, 1999	K-40	1,553.800 ± 178.000	1,408.600 ± 149.000	1,481.200 ± 116.066
SW-4107, 4108	Jun, 1999	Gr. Alpha	3.993 ± 0.919	3.606 ± 0.875	3.800 ± 0.635

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SW-4107, 4108	Jun, 1999	Gr. Beta	6.271 ± 0.754	6.910 ± 0.807	6.591 ± 0.552
SS-4065, 4066	Jun, 1999	K-40	7.350 ± 0.400	7.945 ± 0.370	7.648 ± 0.272
AP-3986, 3987	Jun, 1999	Be-7	0.272 ± 0.147	0.182 ± 0.085	0.227 ± 0.085
G-4007, 4008	Jun, 1999	Be-7	0.830 ± 0.210	0.950 ± 0.200	0.890 ± 0.145
G-4007, 4008	Jun, 1999	K-40	5.790 ± 0.460	4.990 ± 0.400	5.390 ± 0.305
MI-4172, 4173	Jun, 1999	K-40	1,423.600 ± 115.000	1,481.300 ± 129.000	1,452.450 ± 86.409
MI-4293, 4294	Jun, 1999	K-40	1,397.200 ± 179.000	1,388.100 ± 130.000	1,392.650 ± 110.613
AP-4317, 4318	Jun, 1999	Be-7	0.201 ± 0.125	0.213 ± 0.088	0.207 ± 0.076
AP-4894, 4895	Jun, 1999	Be-7	0.092 ± 0.019	0.091 ± 0.014	0.092 ± 0.012
G-4426, 4427	Jun, 1999	Be-7	0.730 ± 0.210	0.630 ± 0.170	0.680 ± 0.135
G-4426, 4427	Jun, 1999	K-40	3.230 ± 0.350	3.400 ± 0.440	3.315 ± 0.281
AP-4454, 4455	Jun, 1999	Be-7	0.205 ± 0.120	0.238 ± 0.087	0.222 ± 0.074
SWU-4601, 4602	Jun, 1999	Gr. Beta	2.209 ± 0.568	1.980 ± 0.589	2.094 ± 0.409
SWU-4601, 4602	Jun, 1999	Gr. Beta	2.209 ± 0.568	1.980 ± 0.589	2.094 ± 0.409
SW-4622, 4623	Jun, 1999	Gr. Beta	2.130 ± 0.854	2.267 ± 0.803	2.198 ± 0.586
AP-4915, 4916	Jun, 1999	Be-7	0.089 ± 0.012	0.094 ± 0.015	0.091 ± 0.010
LW-4974, 4975	Jun, 1999	Gr. Beta	1.916 ± 0.578	2.617 ± 0.644	2.267 ± 0.433
LW-5039, 5040	Jun, 1999	Gr. Beta	2.170 ± 0.610	2.030 ± 0.580	2.100 ± 0.421
LW-5039, 5040	Jun, 1999	H-3	90.659 ± 81.800	162.800 ± 85.000	126.730 ± 58.984
G-4643, 4644	Jul, 1999	Be-7	1.326 ± 0.460	1.555 ± 0.390	1.441 ± 0.302
G-4643, 4644	Jul, 1999	Gr. Beta	5.870 ± 0.151	5.798 ± 0.150	5.834 ± 0.106
G-4643, 4644	Jul, 1999	K-40	5.738 ± 0.780	6.200 ± 0.733	5.969 ± 0.535
SW-4664, 4665	Jul, 1999	Gr. Beta	1.956 ± 0.415	1.836 ± 0.429	1.896 ± 0.298
SW-4664, 4665	Jul, 1999	K-40	1.120	1.120	1.120
WW-4690, 4691	Jul, 1999	Co-60	0.860 ± 1.840	0.374 ± 0.344	0.617 ± 0.936
WW-4690, 4691	Jul, 1999	Cs-137	-0.806 ± 3.130	-2.010 ± 2.610	-1.408 ± 2.038
WW-4690, 4691	Jul, 1999	H-3	399.519 ± 103.570	564.249 ± 109.428	481.884 ± 75.335
WW-4808, 4809	Jul, 1999	Co-60	-0.360 ± 1.910	1.420 ± 25.700	0.530 ± 12.885
WW-4808, 4809	Jul, 1999	Cs-137	0.446 ± 2.260	-1.060 ± 1.720	-0.307 ± 1.420
WW-4808, 4809	Jul, 1999	H-3	72.004 ± 90.621	94.545 ± 91.551	83.274 ± 64.409
MI-4742, 4743	Jul, 1999	K-40	1,344.000 ± 66.000	1,375.000 ± 112.000	1,359.500 ± 65.000
CW-5018, 5019	Jul, 1999	H-3	364.162 ± 92.219	430.163 ± 94.673	397.163 ± 66.082
VE-4873, 4874	Jul, 1999	Be-7	2.023 ± 0.294	1.882 ± 0.338	1.953 ± 0.224
VE-4873, 4874	Jul, 1999	K-40	7.894 ± 0.650	7.394 ± 0.655	7.644 ± 0.461
F-5124, 5125	Jul, 1999	K-40	2.394 ± 0.364	2.802 ± 0.360	2.598 ± 0.256

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
VE-5187, 5188	Jul, 1999	K-40	2.990 ± 0.422	3.265 ± 0.446	3.128 ± 0.307
VE-5187, 5188	Jul, 1999	Sr-90	0.005 ± 0.002	0.002 ± 0.002	0.004 ± 0.002
CW-5212, 5213	Jul, 1999	Gr. Beta	2.187 ± 1.449	2.452 ± 1.381	2.320 ± 1.001
CW-5212, 5213	Jul, 1999	Gr. Beta	-0.405 ± 1.220	-0.438 ± 1.196	-0.422 ± 0.854
MI-5260, 5261	Jul, 1999	K-40	1,367.000 ± 172.000	1,462.000 ± 161.000	1,414.500 ± 117.797
MI-5287, 5288	Jul, 1999	K-40	1,417.900 ± 89.000	1,280.700 ± 163.000	1,349.300 ± 92.857
PW-5237, 5238	Jul, 1999	H-3	189.773 ± 96.797	220.943 ± 97.971	205.358 ± 68.862
AP-5329, 5330	Jul, 1999	Be-7	0.168 ± 0.065	0.140 ± 0.122	0.154 ± 0.069
SWU-5379, 5380	Jul, 1999	Gr. Beta	2.571 ± 0.605	2.219 ± 0.611	2.395 ± 0.430
SWU-5379, 5380	Jul, 1999	H-3	484.749 ± 105.455	520.309 ± 106.709	502.529 ± 75.013
G-5354, 5355	Jul, 1999	Be-7	1.120 ± 0.270	1.030 ± 0.160	1.075 ± 0.157
G-5354, 5355	Jul, 1999	K-40	6.160 ± 0.450	5.990 ± 0.530	6.075 ± 0.348
MI-5520, 5521	Jul, 1999	Co-60	-1.180 ± 3.460	-2.330 ± 2.740	-1.755 ± 2.207
MI-5520, 5521	Jul, 1999	Cs-137	1.450 ± 2.200	3.160 ± 2.660	2.305 ± 1.726
MI-5520, 5521	Jul, 1999	I-131	0.184 ± 0.283	0.009 ± 0.285	0.096 ± 0.201
AP-5499, 5500	Jul, 1999	Be-7	0.181 ± 0.070	0.175 ± 0.066	0.178 ± 0.048
CW-5550, 5551	Jul, 1999	Gr. Beta	1.858 ± 1.362	1.361 ± 1.329	1.609 ± 0.952
CW-5550, 5551	Jul, 1999	Gr. Beta	1.208 ± 1.334	-0.174 ± 0.933	0.517 ± 0.814
WW-5575, 5576	Jul, 1999	H-3	224.412 ± 93.866	220.812 ± 93.728	222.612 ± 66.325
MI-5596, 5597	Jul, 1999	K-40	1,355.200 ± 157.000	1,370.900 ± 191.000	1,363.050 ± 123.622
MI-5644, 5645	Jul, 1999	Calcium	0.830 ± 0.083	0.840 ± 0.084	0.835 ± 0.059
MI-5644, 5645	Jul, 1999	K-40	1,327.000 ± 141.000	1,488.000 ± 169.000	1,407.500 ± 110.048
MI-5644, 5645	Jul, 1999	Sr-90	1.300 ± 0.350	1.070 ± 0.350	1.185 ± 0.247
MI-4742, 4743	Aug, 1999	Sr-90	0.502 ± 0.243	0.702 ± 0.303	0.602 ± 0.194
MI-5666, 5667	Aug, 1999	K-40	1,639.000 ± 161.000	1,724.800 ± 207.000	1,681.900 ± 131.120
WW-5756, 5757	Aug, 1999	Gr. Beta	1.704 ± 0.568	2.432 ± 0.567	2.068 ± 0.401
CW-5712, 5713	Aug, 1999	Gr. Beta	1.906 ± 1.360	1.608 ± 1.270	1.757 ± 0.930
CW-5712, 5713	Aug, 1999	Gr. Beta	-0.269 ± 1.174	-0.634 ± 1.076	-0.451 ± 0.796
G-5735, 5736	Aug, 1999	Be-7	2.961 ± 0.296	3.295 ± 0.492	3.128 ± 0.287
G-5735, 5736	Aug, 1999	K-40	6.731 ± 0.548	6.997 ± 0.492	6.864 ± 0.368
LW-8450, 8451	Aug, 1999	Sr-90	0.390 ± 0.310	0.570 ± 0.310	0.480 ± 0.219
SW-5841, 5842	Aug, 1999	Gr. Alpha	2.850 ± 1.675	2.500 ± 1.685	2.675 ± 1.188
SW-5841, 5842	Aug, 1999	Gr. Beta	9.343 ± 1.425	12.378 ± 1.634	10.860 ± 1.084
VE-5905, 5906	Aug, 1999	Co-60	0.013 ± 0.066	-0.000 ± 0.002	0.006 ± 0.033
VE-5905, 5906	Aug, 1999	Cs-137	0.006 ± 0.008	0.001 ± 0.009	0.004 ± 0.006

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
CW-6148, 6149	Aug, 1999	H-3	141.545 ± 89.443	74.402 ± 86.675	107.974 ± 62.275
PW-5968, 5969	Aug, 1999	H-3	1,625.921 ± 147.401	1,698.481 ± 149.269	1,662.201 ± 104.891
MI-6072, 6073	Aug, 1999	K-40	1,478.600 ± 163.000	1,675.400 ± 202.000	1,577.000 ± 129.782
G-6116, 6117	Aug, 1999	Be-7	4.178 ± 0.306	4.319 ± 0.378	4.248 ± 0.243
G-6116, 6117	Aug, 1999	K-40	5.525 ± 0.548	5.657 ± 0.486	5.591 ± 0.366
AP-6200, 6201	Aug, 1999	K-40	8.465 ± 0.356	8.822 ± 0.666	8.643 ± 0.378
DW-6121, 6122	Aug, 1999	Gr. Beta	1.229 ± 0.325	1.022 ± 0.332	1.126 ± 0.233
SWU-6345, 6346	Aug, 1999	Gr. Beta	2.417 ± 0.582	1.870 ± 0.587	2.144 ± 0.413
MI-6242, 6243	Aug, 1999	Co-60	-1.160 ± 3.210	-0.075 ± 0.105	-0.617 ± 1.606
MI-6242, 6243	Aug, 1999	Cs-137	-0.395 ± 2.610	0.534 ± 2.270	0.070 ± 1.730
MI-6242, 6243	Aug, 1999	I-131	-0.112 ± 0.226	0.119 ± 0.239	0.003 ± 0.164
VE-6263, 6264	Aug, 1999	Co-60	0.001 ± 0.002	0.009 ± 0.027	0.005 ± 0.013
VE-6263, 6264	Aug, 1999	Cs-137	0.010 ± 0.010	-0.004 ± 0.009	0.003 ± 0.007
SW-6389, 6390	Aug, 1999	K-40 (FP)	13.000 ± 1.300	12.000 ± 1.200	12.500 ± 0.885
SWU-6452, 6453	Aug, 1999	Gr. Beta	2.587 ± 0.598	2.053 ± 0.561	2.320 ± 0.410
WW-6604, 6605	Aug, 1999	Gr. Beta	2.199 ± 0.578	1.878 ± 0.594	2.039 ± 0.414
WW-6677, 6678	Aug, 1999	H-3	202.838 ± 101.400	122.240 ± 98.143	162.539 ± 70.559
WW-6506, 6507	Sep, 1999	Co-60	-0.789 ± 7.010	0.416 ± 1.310	-0.187 ± 3.566
WW-6506, 6507	Sep, 1999	Cs-137	0.568 ± 3.270	0.834 ± 3.180	0.701 ± 2.281
WW-6506, 6507	Sep, 1999	H-3	29,273.964 ± 494.519	30,525.051 ± 504.610	29,899.507 ± 353.264
MI-6410, 6411	Sep, 1999	K-40	1,128.500 ± 159.000	1,355.900 ± 174.000	1,242.200 ± 117.853
VE-6431, 6432	Sep, 1999	Gr. Beta	1.880 ± 0.053	1.917 ± 0.053	1.899 ± 0.037
VE-6431, 6432	Sep, 1999	K-40	1.697 ± 0.202	1.603 ± 0.192	1.650 ± 0.139
VE-6558, 6559	Sep, 1999	K-40	2.200 ± 0.204	2.222 ± 0.189	2.211 ± 0.139
AP-6704, 6705	Sep, 1999	Be-7	0.020 ± 0.055	0.018 ± 0.081	0.019 ± 0.049
VE-6649, 6650	Sep, 1999	Co-60	0.008 ± 0.015	-0.001 ± 0.004	0.004 ± 0.008
VE-6649, 6650	Sep, 1999	Cs-137	-0.001 ± 0.007	-0.001 ± 0.007	-0.001 ± 0.005
AP-6727, 6728	Sep, 1999	Be-7	0.109 ± 0.043	0.158 ± 0.089	0.134 ± 0.049
VE-6793, 6794	Sep, 1999	Gr. Beta	1.115 ± 0.037	1.139 ± 0.035	1.127 ± 0.025
SO-6937, 6938	Sep, 1999	Cs-137	0.225 ± 0.027	0.260 ± 0.040	0.243 ± 0.024
SO-6937, 6938	Sep, 1999	K-40	10.450 ± 0.520	10.428 ± 0.760	10.439 ± 0.460
SO-6937, 6938	Sep, 1999	Sr-90	0.041 ± 0.017	0.034 ± 0.014	0.038 ± 0.011
SWU-7045, 7046	Sep, 1999	Gr. Beta	2.623 ± 0.606	2.720 ± 0.593	2.672 ± 0.424
AP-7087, 7088	Sep, 1999	Be-7	0.091 ± 0.068	0.119 ± 0.054	0.105 ± 0.043
PW-7013, 7014	Sep, 1999	H-3	3,002.639 ± 183.527	3,038.815 ± 184.318	3,020.727 ± 130.053

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a]		
			First Result	Second Result	Averaged Result
G-8572, 8573	Oct, 1999	Be-7	3.500 ± 0.338	3.410 ± 0.235	3.455 ± 0.206
G-8572, 8573	Oct, 1999	Gr. Beta	6.249 ± 0.167	6.679 ± 0.171	6.464 ± 0.120
G-8572, 8573	Oct, 1999	K-40	6.900 ± 0.518	6.961 ± 0.374	6.930 ± 0.319
SW-8506, 8507	Oct, 1999	H-3	5,114.000 ± 212.000	5,279.000 ± 215.000	5,196.500 ± 150.971
LW-8747, 8748	Oct, 1999	H-3	4,144.300 ± 194.900	4,392.700 ± 199.513	4,268.500 ± 139.456
SW-8614, 8615	Nov, 1999	Gr. Beta	3.884 ± 0.886	3.386 ± 0.836	3.635 ± 0.609
CW-8641, 8642	Nov, 1999	Gr. Beta	1.310 ± 1.400	2.250 ± 1.470	1.780 ± 1.015
AP-8688, 8689	Nov, 1999	Be-7	0.153 ± 0.083	0.144 ± 0.058	0.149 ± 0.051
SW-8975, 8976	Nov, 1999	H-3	-70.000 ± 85.000	-68.000 ± 85.000	-69.000 ± 60.104
MI-8928, 8929	Nov, 1999	K-40	1,328.300 ± 144.000	1,366.000 ± 163.000	1,347.150 ± 108.749
AP-9179, 9180	Nov, 1999	Be-7	0.145 ± 0.097	0.103 ± 0.055	0.124 ± 0.056
SW-9151, 9152	Nov, 1999	H-3	3,208.000 ± 174.000	3,517.000 ± 180.000	3,362.500 ± 125.176
SW-9227, 9228	Nov, 1999	Co-60	-1.320 ± 12.400	0.120 ± 0.330	-0.600 ± 6.202
SW-9227, 9228	Nov, 1999	Cs-137	0.060 ± 2.330	-0.530 ± 1.660	-0.235 ± 1.430
SW-9227, 9228	Nov, 1999	Gr. Beta	8.590 ± 1.880	9.810 ± 1.980	9.200 ± 1.365
SWU-9275, 9276	Nov, 1999	Gr. Beta	1.590 ± 0.586	1.404 ± 0.529	1.497 ± 0.395
CW-9307, 9308	Dec, 1999	Gr. Beta	0.700 ± 1.500	2.050 ± 1.630	1.375 ± 1.108
CW-9358, 9359	Dec, 1999	Gr. Beta	3.610 ± 0.460	4.210 ± 0.510	3.910 ± 0.343
CW-9358, 9359	Dec, 1999	H-3	14,646.000 ± 339.000	14,764.000 ± 340.000	14,705.000 ± 240.063
MI-9402, 9403	Dec, 1999	K-40	2,074.100 ± 174.000	1,967.700 ± 134.000	2,020.900 ± 109.809
CW-9423, 9424	Dec, 1999	Gr. Beta	1.870 ± 1.610	1.930 ± 1.610	1.900 ± 1.138
AP-9478, 9479	Dec, 1999	Be-7	0.156 ± 0.098	0.091 ± 0.058	0.123 ± 0.057
BS-9587, 9588	Dec, 1999	K-40	11.890 ± 0.550	11.624 ± 0.740	11.757 ± 0.461
LW-9525, 9526	Dec, 1999	Be-7	2.690 ± 0.630	2.340 ± 0.620	2.515 ± 0.442
AP-9767, 9768	Dec, 1999	Be-7	0.104 ± 0.072	0.144 ± 0.085	0.124 ± 0.056
SWU-9837, 9838	Dec, 1999	Gr. Beta	1.530 ± 0.530	2.504 ± 0.607	2.017 ± 0.403
CW-9870, 9871	Dec, 1999	H-3	1,221.000 ± 123.000	1,027.000 ± 117.000	1,124.000 ± 84.879
SW-9964, 9965	Dec, 1999	Co-60	-0.740 ± 2.710	0.950 ± 2.110	0.105 ± 1.717
SW-9964, 9965	Dec, 1999	Cs-137	-2.910 ± 3.140	1.830 ± 2.230	-0.540 ± 1.926
AP-10027, 10028	Dec, 1999	Be-7	0.059 ± 0.008	0.064 ± 0.011	0.062 ± 0.007
SW-9912, 9913	Dec, 1999	H-3	29.000 ± 87.000	113.000 ± 91.000	71.000 ± 62.948
WW-10069, 10070	Dec, 1999	Gr. Beta	2.539 ± 0.664	2.223 ± 0.591	2.381 ± 0.445

[a] All concentrations are reported in pCi/liter, except solid samples, which are reported in pCi/gram.

[b] Lab codes are comprised of the sample media and the sample numbers. Client codes have been eliminated to protect client anonymity.

Table A-5. In-house "duplicate" samples.

Lab Codes	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SWT-7964, 7965	Sep, 1999	Sr-90	0.826 ± 0.411	0.501 ± 0.285	0.664 ± 0.250
W-7302, 7303	Sep, 1999	H-3	364.860 ± 109.550	221.740 ± 104.150	293.300 ± 75.578
SS-7432, 7433	Sep, 1999	K-40	8.619 ± 0.487	8.049 ± 0.508	8.334 ± 0.352
AP-7541, 7542	Sep, 1999	Be-7	0.086 ± 0.012	0.092 ± 0.014	0.089 ± 0.009
AP-7520, 7521	Sep, 1999	Be-7	0.087 ± 0.012	0.091 ± 0.011	0.089 ± 0.008
PW-7228, 7229	Oct, 1999	H-3	6,053.000 ± 243.000	6,177.000 ± 245.000	6,115.000 ± 172.536
SW-7252, 7253	Oct, 1999	H-3	544.000 ± 116.000	659.000 ± 120.000	601.500 ± 83.451
SO-7344, 7345	Oct, 1999	Cs-137	0.067 ± 0.020	0.066 ± 0.023	0.067 ± 0.015
SO-7344, 7345	Oct, 1999	Gr. Beta	27.800 ± 3.580	26.320 ± 3.550	27.060 ± 2.521
SO-7344, 7345	Oct, 1999	K-40	18.510 ± 0.690	19.680 ± 0.810	19.095 ± 0.532
SO-7344, 7345	Oct, 1999	Sr-90	0.020 ± 0.009	0.014 ± 0.008	0.017 ± 0.006
WW-7365, 7366	Oct, 1999	Gr. Beta	1.712 ± 0.500	1.341 ± 0.482	1.527 ± 0.347
WW-7365, 7366	Oct, 1999	K-40	1.200 ± 0.120	1.100 ± 0.110	1.150 ± 0.081
MI-7323, 7324	Oct, 1999	K-40	1,404.100 ± 111.000	1,374.200 ± 181.000	1,389.150 ± 106.163
F-7478, 7479	Oct, 1999	Co-60	0.010 ± 0.050	0.000 ± 0.010	0.005 ± 0.025
F-7478, 7479	Oct, 1999	Cs-137	0.000 ± 0.010	-0.010 ± 0.010	-0.005 ± 0.007
MI-7728, 7729	Oct, 1999	K-40	1,567.700 ± 170.000	1,471.900 ± 125.000	1,519.800 ± 105.505
MI-7587, 7588	Oct, 1999	K-40	1,263.200 ± 162.000	1,449.800 ± 122.000	1,356.500 ± 101.400
AP-7619, 7620	Oct, 1999	Be-7	0.166 ± 0.071	0.110 ± 0.090	0.138 ± 0.057
SL-7749, 7750	Oct, 1999	Gr. Beta	3.088 ± 0.278	3.320 ± 0.285	3.204 ± 0.199
SL-7749, 7750	Oct, 1999	K-40	1.190 ± 0.560	2.160 ± 0.500	1.675 ± 0.375
BS-7943, 7944	Oct, 1999	Gr. Beta	13.816 ± 2.943	14.263 ± 2.888	14.040 ± 2.062
BS-7943, 7944	Oct, 1999	K-40	11.681 ± 0.551	12.691 ± 0.754	12.186 ± 0.467
G-7898, 7899	Oct, 1999	Be-7	1.315 ± 0.188	1.342 ± 0.186	1.329 ± 0.132
G-7898, 7899	Oct, 1999	K-40	6.436 ± 0.449	6.292 ± 0.486	6.364 ± 0.331
CW-8058, 8059	Oct, 1999	Gr. Beta	2.520 ± 1.490	2.320 ± 1.490	2.420 ± 1.054
F-8379, 8380	Oct, 1999	K-40	2.980 ± 0.240	3.063 ± 0.262	3.021 ± 0.178
F-8171, 8172	Oct, 1999	Co-60	-0.010 ± 0.020	-0.010 ± 0.010	-0.010 ± 0.011
F-8171, 8172	Oct, 1999	Cs-137	-0.010 ± 0.010	0.000 ± 0.010	-0.005 ± 0.007
SWU-8316, 8317	Oct, 1999	Gr. Beta	2.310 ± 0.690	2.248 ± 0.691	2.279 ± 0.488
SWU-8316, 8317	Oct, 1999	H-3	187.623 ± 94.958	223.391 ± 96.366	205.507 ± 67.645
SP-8954, 8955	Oct, 1999	Gr. Beta	6.535 ± 1.721	4.745 ± 1.412	5.640 ± 1.113
CW-8425, 8426	Oct, 1999	Gr. Beta	1.720 ± 1.430	1.510 ± 1.410	1.615 ± 1.004
SS-8474, 8475	Oct, 1999	K-40	9.117 ± 0.719	9.634 ± 0.542	9.376 ± 0.450
LW-8747, 8748	Oct, 1999	Gr. Beta	1.984 ± 0.431	2.120 ± 0.476	2.052 ± 0.321

Table A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP), comparison of MAPEP and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	MAPEP Result[d] 1s, N=1	Control Limits
SPW-846	WATER	Jan, 1999	Co-57	337.60 ± 33.76	358.00	250.60 - 465.40
SPW-846	WATER	Jan, 1999	Cs-137	656.60 ± 65.66	637.00	445.90 - 828.10
SPW-846	WATER	Jan, 1999	Fe-55	724.50 ± 72.45	664.00	464.80 - 863.20
SPW-846	WATER	Jan, 1999	Mn-54	234.20 ± 23.42	229.00	160.30 - 297.70
SPW-846	WATER	Jan, 1999	Pu-238	1.10 ± 0.11	1.45	1.02 - 1.89
SPW-846	WATER	Jan, 1999	Pu-239/40	3.20 ± 0.32	4.04	2.83 - 5.25
SPW-846	WATER	Jan, 1999	Sr-90	40.90 ± 4.09	39.50	27.65 - 51.35
SPW-846	WATER	Jan, 1999	U-233/4	2.70 ± 0.27	2.67	1.87 - 3.47
SPW-846	WATER	Jan, 1999	U-238	20.80 ± 2.08	21.20	14.84 - 27.56
SPW-846	WATER	Jan, 1999	Zn-65	1,508.90 ± 150.90	1,560.00	1,092.00 - 2,028.00
STSO-854	SOIL	Jan, 1999	Am-241	6.16 ± 0.70	6.55	4.59 - 8.52
STSO-854	SOIL	Jan, 1999	Co-57	311.11 ± 3.60	360.00	252.00 - 468.00
STSO-854	SOIL	Jan, 1999	Co-60	134.57 ± 2.15	131.00	91.70 - 170.30
STSO-854	SOIL	Jan, 1999	Cs-134	682.35 ± 4.50	752.00	526.40 - 977.60
STSO-854	SOIL	Jan, 1999	Cs-137	319.50 ± 3.60	331.00	231.70 - 430.30
STSO-854	SOIL	Jan, 1999	K-40	667.04 ± 21.50	652.00	456.40 - 847.60
STSO-854	SOIL	Jan, 1999	Mn-54	349.01 ± 7.00	345.00	241.50 - 448.50
STSO-854	SOIL	Jan, 1999	Pu-238	25.28 ± 1.00	27.50	19.25 - 35.75
STSO-854	SOIL	Jan, 1999	Pu-239/40	45.66 ± 1.00	48.10	33.67 - 62.53
STSO-854	SOIL	Jan, 1999	U-233/4	139.56 ± 1.80	157.00	109.90 - 204.10
STSO-854	SOIL	Jan, 1999	U-238	23.47 ± 0.75	40.70	28.49 - 52.91
	No errors were found in the calculations or the analytical process. The analysis is being repeated.					
STSO-854	SOIL	Jan, 1999	Zn-65	2,697.20 ± 25.00	2,840.00	1,988.00 - 3,692.00

[a] Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the Department of Energy's Mixed Analyte Performance Evaluation Program, Idaho Operations office, Idaho Falls, Idaho.

[b] All results are in Bq/kg or Bq/L as requested by the Department of Energy.

[c] Unless otherwise indicated, the TBEESML results are given as the mean ± 1 standard deviations for three determinations.

[d] MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP.

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	EML Result[d]	Control Limits[e]
STAF-848	AIR FILTER	Mar, 1999	Gr. Alpha	1.24 ± 0.03	1.61 ± 0.16	0.60 - 1.64
STAF-848	AIR FILTER	Mar, 1999	Gr. Beta	1.98 ± 0.04	1.56 ± 0.16	0.60 - 1.64
STW-850	WATER	Mar, 1999	Am-241	1.22 ± 0.16	1.15 ± 0.05	0.50 - 1.50
STW-850	WATER	Mar, 1999	Co-60	54.40 ± 2.00	51.10 ± 3.00	0.92 - 1.18
STW-850	WATER	Mar, 1999	Cs-137	43.50 ± 2.00	39.38 ± 2.41	0.90 - 1.28
STW-850	WATER	Mar, 1999	Fe-55	81.50 ± 19.50	97.40 ± 1.65	0.31 - 1.54
STW-850	WATER	Mar, 1999	Gr. Alpha	1,169.00 ± 37.00	1,090.00 ± 20.00	0.50 - 1.29
STW-850	WATER	Mar, 1999	Gr. Beta	1,274.60 ± 33.30	1,100.00 ± 40.00	0.50 - 1.29
STW-850	WATER	Mar, 1999	H-3	90.30 ± 24.80	121.08 ± 6.78	0.65 - 1.91
STW-850	WATER	Mar, 1999	Ni-63	125.80 ± 6.30	114.00 ± 10.00	0.50 - 1.50
STW-850	WATER	Mar, 1999	Pu-238	0.80 ± 0.01	0.77 ± 0.04	0.78 - 1.42
STW-850	WATER	Mar, 1999	Pu-239/40	1.03 ± 0.07	1.01 ± 0.06	0.78 - 1.42
STW-850	WATER	Mar, 1999	Sr-90	3.63 ± 1.20	4.10 ± 0.05	0.50 - 1.50
STW-850	WATER	Mar, 1999	U-233/4	0.33 ± 0.08	0.27 ± 0.02	0.77 - 1.35
STW-850	WATER	Mar, 1999	U-238	0.33 ± 0.08	0.26 ± 0.02	0.77 - 1.35
STVE-851	VEGETATION	Mar, 1999	Am-241	3.35 ± 0.85	3.52 ± 0.59	0.68 - 2.78
STVE-851	VEGETATION	Mar, 1999	Cm-244	0.56 ± 0.41	1.67 ± 0.54	0.49 - 1.69
STVE-851	VEGETATION	Mar, 1999	Co-60	21.00 ± 1.90	21.45 ± 1.00	0.62 - 1.42
STVE-851	VEGETATION	Mar, 1999	Cs-137	453.90 ± 5.70	467.00 ± 20.00	0.81 - 1.45
STVE-851	VEGETATION	Mar, 1999	K-40	667.60 ± 33.70	656.50 ± 20.00	0.79 - 1.50
STVE-851	VEGETATION	Mar, 1999	Sr-90	704.80 ± 27.80	736.10 ± 7.70	0.48 - 1.29
STSO-852	SOIL	Mar, 1999	Ac-228	45.10 ± 7.40	47.15 ± 2.99	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Am-241	5.65 ± 2.41	4.89 ± 0.97	0.52 - 2.65
STSO-852	SOIL	Mar, 1999	Bi-214	67.30 ± 3.30	69.90 ± 5.66	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Cs-137	620.50 ± 5.90	659.50 ± 24.95	0.80 - 1.34
STSO-852	SOIL	Mar, 1999	K-40	355.70 ± 24.60	362.75 ± 20.16	0.73 - 1.67
STSO-852	SOIL	Mar, 1999	Pb-212	47.90 ± 3.00	47.93 ± 2.57	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Pb-214	70.10 ± 4.80	71.00 ± 7.04	0.50 - 1.50
STSO-852	SOIL	Mar, 1999	Pu-239/40	7.32 ± 1.32	8.11 ± 1.07	0.66 - 1.93
STSO-852	SOIL	Mar, 1999	Sr-90	28.30 ± 3.50	32.40 ± 0.53	0.46 - 2.84
STSO-852	SOIL	Mar, 1999	Th-234	227.40 ± 35.20	138.00 ± 4.08	0.50 - 2.00
STSO-852	SOIL	Mar, 1999	U-233/4	132.90 ± 6.90	140.67 ± 1.16	0.35 - 1.55
STSO-852	SOIL	Mar, 1999	U-238	139.40 ± 7.00	145.00 ± 1.73	0.35 - 1.55
STAF-853	AIR FILTER	Mar, 1999	Am-241	0.14 ± 0.02	0.13 ± 0.01	0.68 - 2.41
STAF-853	AIR FILTER	Mar, 1999	Co-57	3.32 ± 0.06	3.01 ± 0.14	0.62 - 1.22
STAF-853	AIR FILTER	Mar, 1999	Co-60	5.28 ± 0.15	4.96 ± 0.28	0.62 - 1.42
STAF-853	AIR FILTER	Mar, 1999	Cs-137	6.96 ± 0.15	6.05 ± 0.30	0.72 - 1.32
STAF-853	AIR FILTER	Mar, 1999	Pu-238	0.26 ± 0.02	0.27 ± 0.00	0.62 - 1.46

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration[b] Teledyne Result[c]	EML Result[d]	Control Limits[e]
STAF-853	AIR FILTER	Mar, 1999	Pu-239/40	0.12 ± 0.02	0.12 ± 0.00	0.62 - 1.46
STAF-853	AIR FILTER	Mar, 1999	Sb-125	4.35 ± 0.30	3.59 ± 0.31	0.62 - 1.39
STAF-853	AIR FILTER	Mar, 1999	Sr-90	0.65 ± 0.19	0.64 ± 0.01	0.66 - 2.65
STAF-853	AIR FILTER	Mar, 1999	U-233/4	0.07 ± 0.03	0.06 ± 0.00	0.78 - 3.00
STAF-853	AIR FILTER	Mar, 1999	U-238	0.07 ± 0.03	0.06 ± 0.00	0.78 - 3.00

[a] The Environmental Measurements Laboratory provides the following nuclear species : Air Filters, Soil, Vegetation and Water.

[b] Results are reported in Bq/L with the following exceptions: Air Filter results are reported in Bq/Filter, Soil results are reported in Bq/Kg, Vegetation results are reported in Bq/Kg.

[c] Teledyne results are reported as the mean of three determinations±standard deviation.

[d] The EML result listed is the mean of replicate determinations for each nuclide±the standard error of the mean.

[e] The control limits are reported by EML as the ratio of Reported Value / EML value and are established from percentiles of historic data distributions (1982-1992). The evaluation of this historic data and the development of the control limits is presented in DOE report EML-564.

APPENDIX B

DATA REPORTING CONVENTIONS

Data Reporting Conventions

1.0. All activities, except gross alpha and gross beta, are decay corrected to collection time or the end of the collection period.

2.0. Single Measurements

Each single measurement is reported as follows: $x \pm s$

where: x = value of the measurement;

$s = 2s$ counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is less than the lower limit of detection L, it is reported as: <L,

where L = the lower limit of detection based on 4.66s uncertainty for a background sample.

3.0. Duplicate analyses

3.1 Individual results: For two analysis reults; $x_1 \pm s_1$ and $x_2 \pm s_2$

Reported result: $x \pm s$; where $x = (1/2)(x_1 + x_2)$ and $s = (1/2)\sqrt{s_1^2 + s_2^2}$

3.2. Individual results: $<L_1$, $<L_2$ Reported result: <L, where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$, <L Reported result: $x \pm s$ if x L; <L otherwise.

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\bar{x}$ and standard deviation s of a set of n numbers $x_1, x_2 \ldots x_n$ are defined as follows:

$$\bar{x} = \frac{1}{n} x \qquad s = \sqrt{\frac{(x - \bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

4.5 In rounding off, the following rules are followed:

4.5.1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2. If the figure following those to be retained is equal to or greater than 5, the figure is dropped and the last retained figure is raised by 1. As an example, 11.445 is rounded off to 11.45.

APPENDIX C

Effluent Concentration Limit of Radioactivity in Air and Water Above Natural Background in Unrestricted Areas

Table C-1

Effluent Concentration Limit of Radioactivity in Air and Water Above Natural Background in Unrestricted Areas[a]

Air		Water	
Gross Alpha	1E-03 pCi/m^3	Strontium-89	8,000 pCi/l
Gross Beta	1 pCi/m^3	Strontium-90	500 pCi/l
Iodine-131[b]	2.86E-01 pCi/m^3	Cesium-137	1,000 pCi/l
		Barium-140	8,000 pCi/l
		Iodine-131	1,000 pCi/l
		Potassium-40[c]	4,000 pCi/l
		Gross Alpha	2 pCi/l
		Gross Beta	100 pCi/l
		Tritium	$1x10^6$ pCi/l

[a] Taken from Code of Federal Regulation Title 10, Part 20, Table II and appropriate footnotes. Concentrations may be averaged over a period not greater than one year.

[b] From 10 CFR 20 but adjusted by a factor of 700 to reduce the dose resulting from the air-grass-cow-child pathway.

[c] A natural radionuclide.

APPENDIX D

REMP SAMPLING SUMMARY

Table 4.5 Radiological Environmental Monitoring Program Summary

Name of Facility: Davis-Besse Nuclear Power Station
Location of Facility: Ottawa, Ohio (County, State)
Docket No. 50-346
Reporting Period: January-December, 1999

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Airborne Particulates (pCi/m³)	GB 520	0.005	0.023 (311/312) (0.007-0.056)	T-2, Site Boundary 0.9 mi. E	0.025 (52/52) (0.011-0.056)	0.023 (208/208) (0.010-0.054)	0
	Sr-89	0.0029	< LLD	-	-	< LLD	0
	Sr-90	0.0019	< LLD	-	-	< LLD	0
	GS 40						
	Be-7	0.015	0.076 (24/24) (0.059-0.097)	T-9, Oak Harbor 6.8 mi. SW	0.081 (4/4) (0.058-0.097)	0.078 (16/16) (0.058-0.097)	0
	K-40	0.036	< LLD	-	-	< LLD	0
	Nb-95	0.0017	< LLD	-	-	< LLD	0
	Zr-95	0.0018	< LLD	-	-	< LLD	0
	Ru-103	0.0010	< LLD	-	-	< LLD	0
	Ru-106	0.0087	< LLD	-	-	< LLD	0
	Cs-134	0.0019	< LLD	-	-	< LLD	0
	Cs-137	0.0009	< LLD	-	-	< LLD	0
	Ce-141	0.0021	< LLD	-	-	< LLD	0
	Ce-144	0.0052	< LLD	-	-	< LLD	0
Airborne Iodine (pCi/m³)	I-131 520	0.07	< LLD	-	-	< LLD	0
TLD (Quarterly) (mR/91 days)	Gamma[f] 295	1.0	14 (252/252) (7.3-23.2)	T-67, Site Boundary 0.3 mi. NNW	77.4 (4/4) (16.7-21.1)	15.1 (43/43) (10.7-20.9)	0
TLD (Quarterly) (mR/91 days) (Shield)	Gamma 4	1.0	5.5 (4/4) (5.4-5.7)	-	-	None	0
TLD (Annual) (mR/365 days)	Gamma 74	1.0	53.3 (63/63) (33.5-82.0)	T-45, Site Boundary 0.5 mi. WNW	82.0 (1/1) -	59.7 (11/11) (45.1-71.5)	0
TLD (Annual) (mR/365 days) (Shield)	Gamma 1	1.0	21.4 (1/1)	-	-	None	0

Table 4.5 Radiological Environmental Monitoring Program Summary

Name of Facility: Davis-Besse Nuclear Power Station — Docket No. 50-346
Location of Facility: Ottawa, Ohio (County, State) — Reporting Period: January-December, 1999

Sample Type (Units)	Type and Number of Analyses[a]		LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean Location[d]	Location with Highest Annual Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Milk (pCi/L)	I-131	12	0.5	none	-	-	< LLD	0
	Sr-89	12	0.9	none	-	-	< LLD	0
	Sr-90	12	0.5	none	T-24, Sandusky 21.0 mi. SE	0.9 (12/12) (0.6-1.2)	0.9 (12/12) (0.6-1.2) —	0
	GS	12						
	K-40		100	none	T-24, Sandusky 21.0 mi. SE	1392 (12/12) (1269-1465)	1392 (12/12) (1269-1465)	0
	Cs-137		10	none	-	-	< LLD	0
	Ba-La-140		10	none	-	-	< LLD	0
(g/L)	Ca	12	0.50	none	T-24, Sandusky 21.0 mi. SE	0.88 (12/12) (0.80-0.95)	0.88 (12/12) (0.80-0.95)	0
(g/L)	K (stable)	12	0.10	none	T-24, Sandusky 21.0 mi. SE	1.61 (12/12) (1.47-1.69)	1.61 (12/12) (1.47-1.69)	0
(pCi/g)	Sr-90/Ca	12	0.36	none	T-24, Sandusky 21.0 mi. SE	1.02 (12/12) (0.63-1.43)	1.02 (12/12) (0.63-1.43)	0
(pCi/g)	Cs-137/K	12	5.08	none	-	-	< LLD	0
Ground Water (pCi/L)	GB (TR)	5	2.2	3.6 (1/1)	T-54, Farm 4.8 mi. SW	3.6 (1/1)	< LLD	
	H-3	5	330	< LLD	-	-	< LLD	0
	Sr-89	5	1.1	< LLD	-	-	< LLD	0
	Sr-90	5	0.7	< LLD	-	-	< LLD	0
	GS							
	Mn-54		15	< LLD	-	-	< LLD	0
	Fe-59		30	< LLD	-	-	< LLD	0
	Co-58		15	< LLD	-	-	< LLD	0
	Co-60		15	< LLD	-	-	< LLD	0
	Zn-65		30	< LLD	-	-	< LLD	0
	Zr-95		15	< LLD	-	-	< LLD	0
	Cs-134		10	< LLD	-	-	< LLD	0
	Cs-137		10	< LLD	-	-	< LLD	0
	Ba-La-140		15	< LLD	-	-	< LLD	0

Table 4.5 Radiological Environmental Monitoring Program Summary

Name of Facility: Davis-Besse Nuclear Power Station — Docket No. 50-346
Location of Facility: Ottawa, Ohio — Reporting Period: January-December, 1999
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean Location[d]	Location with Highest Annual Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Treated Surface Water (pCi/L)	GB (TR) 48	1.0	2.4 (24/24) (1.3-5.9)	T-50, Erie Ind. Park 4.5 mi. SE	2.4 (12/12) (1.4-5.9)	2.1 (24/24) (1.0-3.9)	0
	H-3 16	330	< LLD	-	-	< LLD	0
	Sr-89 16	0.9	< LLD	-	-	< LLD	0
	Sr-90 16	0.6	< LLD	T-11, Port Clinton WTP, 9.5 mi. SE	0.7 (2/4)	0.7 (2/8)—	0
	GS 16						
	Mn-54	15	< LLD	-	-	< LLD	0
	Fe-59	30	< LLD	-	-	< LLD	0
	Co-58	15	< LLD	-	-	< LLD	0
	Co-60	15	< LLD	-	-	< LLD	0
	Zn-65	30	< LLD	-	-	< LLD	0
	Zr-Nb-95	15	< LLD	-	-	< LLD	0
	Cs-134	10	< LLD	-	-	< LLD	0
	Cs-137	10	< LLD	-	-	< LLD	0
	Ba-La-140	15	< LLD	-	-	< LLD	0
Untreated Surface Water (pCi/L)	GB (TR) 129	1.0	2.6 (77/77) (1.5-4.6)	T-152, Maumee Bay S.P., 15.6 mi. WNW	3.4 (7/7) (1.8-4.6)	2.4 (52/52) (1.7-6.7)	0
	H-3 129	330	465 (6/6) (367-550)	T-137, Lake Erie 7.0 mi. WNW	3008 (2/2) (371-5645)	1673 (3/3) (337-5645)	0
		330					
	Sr-89 20	1.0	< LLD	-	-	< LLD	0
	Sr-90 20	0.9	< LLD	-	-	< LLD	0
	GS 129						
	Mn-54	15	< LLD	-	-	< LLD	0
	Fe-59	30	< LLD	-	-	< LLD	0
	Co-58	15	< LLD	-	-	< LLD	0
	Co-60	15	< LLD	-	-	< LLD	0
	Zn-65	30	< LLD	-	-	< LLD	0
	Zr-Nb-95	15	< LLD	-	-	< LLD	0
	Cs-134	10	< LLD	-	-	< LLD	0
	Cs-137	10	< LLD	-	-	< LLD	0
	Ba-La-140	15	< LLD	-	-	< LLD	0

Table 4.5 Radiological Environmental Monitoring Program Summary

Name of Facility: Davis-Besse Nuclear Power Station — Docket No. 50-346
Location of Facility: Ottawa, Ohio (County, State) — Reporting Period: January-December, 1999

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Edible Meat (pCi/g wet)	GS 3						
	K-40	0.10	2.99 (2/2) ((2.76-3.22)	T-197, Farm 1.7 mi. W	3.22 (1/1)	2.66 (1/1)	0
	Cs-137	0.028	< LLD	-	-	< LLD	0
Fruits and Vegetables (pCi/g wet)	Sr-89 3	0.004	< LLD	-	-	< LLD	0
	Sr-90 3	0.001	0.002 (1/2)	T-25, Farm 3.7 mi. WSW	0.002 (1/1)	< LLD	0
	I-131 3	0.021	< LLD	-	-	< LLD	0
	GS 3						
	K-40	0.50	1.17 (2/2) (0.67-1.66)	T-8, Farm 2.7 mi. WSW	1.66 (1/1)	0.99 (1/1)	0
	Nb-95	0.008	< LLD	-	-	< LLD	0
	Zr-95	0.022	< LLD	-	-	< LLD	0
	Cs-137	0.013	< LLD	-	-	< LLD	0
	Ce-141	0.017	< LLD	-	-	< LLD	0
	Ce-144	0.056	< LLD	-	-	< LLD	0
Broad Leaf Vegetation (pCi/g wet)	Sr-89 10	0.010	< LLD	-	-	< LLD	0
	Sr-90 10	0.006	< LLD	-	-	< LLD	0
	I-131 10	0.028	< LLD	-	-	< LLD	0
	GS 10						
	K-40	0.50	2.61 (6/6) (2.01-3.69)	T-17, Site Boundary 0.7 mi. SW	2.94 (3/3) (2.01-3.69)	2.47 (4/4) (1.86-3.19)	0
	Nb-95	0.022	< LLD	-	-	< LLD	0
	Zr-95	0.032	< LLD	-	-	< LLD	0
	Cs-137	0.017	< LLD	-	-	< LLD	0
	Ce-141	0.038	< LLD	-	-	< LLD	0
	Ce-144	0.15	< LLD	-	-	< LLD	0

Table 4.5 Radiological Environmental Monitoring Program Summary

Name of Facility: Davis-Besse Nuclear Power Station — Docket No. 50-346
Location of Facility: Ottawa, Ohio (County, State) — Reporting Period: January-December, 1999

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Animal / Wildlife Feed (pCi/g wet)	GS 5						
	Be-7	0.32	0.79 (1/4)	T-32, Onsite Roving location	0.79 (1/1)	< LLD	0
	K-40	0.10	4.95 (4/4) (2.80-6.98)	T-34, Offsite Roving location	7.04 (1/1)	7.04 (1/1) ---	0
	Nb-95	0.043	< LLD	-	-	< LLD	0
	Zr-95	0.044	< LLD	-	-	< LLD	0
	Ru-103	0.034	< LLD	-	-	< LLD	0
	Ru-106	0.26	< LLD	-	-	< LLD	0
	Cs-137	0.028	< LLD	-	-	< LLD	0
	Ce-141	0.074	< LLD	-	-	< LLD	0
	Ce-144	0.20	< LLD	-	-	< LLD	0
Soil (pCi/g dry)	GS 20						
	Be-7	0.72	1.03 (1/1)	T-2, Site Boundary. 0.9 mi. E	1.03 (1/1)	0.73 (1/1)	0
	K-40	0.10	13.58 (12/12) (6.38-25.34)	T-9, Oak Harbor 6.8 mi. SW	24.22 (2/2) (23.40-25.03)	21.10 (8/8) (13.43-25.03)	0
	Nb-95	0.15	< LLD	-	-	< LLD	0
	Zr-95	0.22	< LLD	-	-	< LLD	0
	Ru-103	0.075	< LLD	-	-	< LLD	0
	Ru-106	0.34	< LLD	-	-	< LLD	0
	Cs-137	0.045	0.29 (7/12) (0.13-0.46)	T-8, Farm 2.7 mi. WSW	0.40 (2/2) (0.39-0.40)	0.23(7/8) (0.11-0.49)	0
	Ce-141	0.17	< LLD	-	-	< LLD	0
	Ce-144	0.31	< LLD	-	-	< LLD	0

Table 4.5 Radiological Environmental Monitoring Program Summary

Name of Facility: Davis-Besse Nuclear Power Station — Docket No. 50-346
Location of Facility: Ottawa, Ohio (County, State) — Reporting Period: January-December, 1999

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Fish (pCi/g wet)	GB 6	0.1	3.13 (3/3) (2.56-3.89)	T-33, Lake Erie 1.5 mi. NE	3.13 (3/3) (2.56-3.89)	2.78 (3/3) (2.47-3.36)	0
	GS 6						
	K-40	0.10	3.12 (3/3) (2.76-3.55)	T-33, Lake Erie 1.5 mi. NE	7.04 (1/1)	2.88 (3/3) (2.37-3.44)[f]	0
	Mn-54	0.020	< LLD	-	-	< LLD	0
	Fe-59	0.058	< LLD	-	-	< LLD	0
	Co-58	0.031	< LLD	-	-	< LLD	0
	Co-60	0.026	< LLD	-	-	< LLD	0
	Zn-65	0.046	< LLD	-	-	< LLD	0
	Cs-134	0.023	< LLD	-	-	< LLD	0
	Cs-137	0.023	< LLD	-	-	< LLD	0
Shoreline Sediments (pCi/g dry)	GS 8						
	K-40	0.10	14.49 (6/6) (10.93-21.03)	T-4, Site Boundary 0.8 mi. S	16.75 (2/2) (12.47-21.03)	10.71 (2/2) (10.03-11.39)	0
	Mn-54	0.047	< LLD	-	-	< LLD	0
	Co-58	0.077	< LLD	-	-	< LLD	0
	Co-60	0.029	< LLD	-	-	< LLD	0
	Cs-134	0.051	< LLD	-	-	< LLD	0
	Cs-137	0.052	< LLD	-	-	< LLD	0

[a] GB = gross beta, GS = gamma scan.

[b] LLD = nominal lower limit of detection based on a 4.66 sigma counting error for background sample.

[c] Mean and range are based on detectable measurements only (i.e., >LLD) Fraction of detectable measurements at specified locations is indicated in parentheses (F).

[d] Locations are specified by station code (Table 4.1) and distance (miles) and direction relative to reactor site..

[e] Non-routine results are those which exceed ten times the control station value.

[f] The first quarter TLD result (T-91, 3.4 ± 0.2 mR/91 days) was eliminated from the mean calculation . The TLD was damaged in the field.

DAVIS-BESSE NUCLEAR POWER STATION

PROCESS CONTROL PROGRAM

REVISION 6, 1999

Effective Date: 4/19/99

Approval:

SRB Chairman — Date: 4/7/99

Plant Manager — Date: 4/8/99

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Revision	Approval/Effective Date
0	2/21/84
1	8/29/85
2	5/21/86
3	1/27/89
4	2/22/91
5	12/18/92

DAVIS-BESSE NUCLEAR POWER STATION
PROCESS CONTROL PROGRAM

Solid Radioactive Waste Process Control Program

I. PURPOSE

The processing of radioactive waste for disposal at a licensed radioactive waste burial site requires that the waste be appropriately analyzed, processed and packaged, representing a final waste form that is acceptable for transportation to and burial at a licensed radioactive waste disposal site. The purpose of this Process Control Program is to document the radioactive waste processing methods and the quality control steps that are taken at Davis-Besse to verify compliance with applicable regulatory requirements and, in particular, to assure an acceptable waste product meeting the applicable waste stability characteristics of 10 CFR 61.56.

This Process Control Program covers all major waste processing streams at Davis-Besse and the resulting final waste products, including:

- Compressible and non-compressible trash;
- Spent aqueous system filter cartridges;
- Spent resins; and
- Use of contractor for waste processing.

This Process Control Program shall be used to verify the Solidification or Dewatering of at least one representative test specimen from at least 25% of the batches of each type of wet radioactive waste (e.g., filter sludges, spent resins, evaporator bottoms, and boric acid solutions), or once every two years if no verification has been performed.

Solidification shall be the conversation of wet radioactive wastes into a form that meets destination waste disposal site criteria by the removal of freestanding water through chemical processes. Dewatering shall be the conversion of wet radioactive wastes into a form that meets destination waste disposal site criteria by the removal freestanding water through physical processes.

If provisions of this Process Control Program are not satisfied, shipments for direct disposal of defectively processed or defectively packaged solid radioactive wastes from the site shall be suspended.

If a container of wet waste is being sent to an offsite processor, then only gross dewatering and the requirements of the processor's waste acceptance criteria need be met.

The requirements for solid radioactive waste handling and disposal given under this program provide assurance that solid radioactive materials shipped offsite, meet destination disposal site requirements and are packaged in conformance with 10 CFR Part 20, 10 CFR Part 71, 10 CFR Part 61 and 49 CFR Parts 170-178.

II. REGULATORY OVERVIEW

All waste processing, packaging and shipping are conducted in accordance with approved procedures to assure compliance with applicable federal, state and burial site requirements. Waste processed for disposal is evaluated for compliance with:

1. The waste classification requirements of 10 CFR 61.55.
2. The waste characteristic requirements of 10 CFR 61.56.
3. The manifest reporting requirements of 10 CFR 71 and 10 CFR 20.2006.

Packaging of waste is in containers meeting DOT specifications and is appropriate for the applicable waste class. Shipments are conducted in accordance with the requirements of 49 CFR 172-177 and 10 CFR 71.

All waste processing is performed in a manner consistent with the principles of ALARA. The procedures that have been developed to cover waste processing operations address appropriate radiation safety measures such as job planning (RWP), radiation source shielding, and job prerequisites and material requirements so as to minimize stay times.

III. SOLID RADWASTE PROCESSING AND PACKAGING

Prior to the placing any radioactive material in a container for shipment off-site, a visual inspection of the container's general condition and integrity is conducted. Specific items leading to potential container degradation that are examined and could result in rejection for use as a radwaste disposal container include:

- Punctures
- Corrosion

- Cracked, separated, incomplete or otherwise defective seams and welds
- bent, dented, cut or degraded gaskets and/or sealing surfaces

Compressible and Non-Compressible Waste

Miscellaneous compressible and non-compressible wastes are routinely collected throughout the radiologically controlled areas of the plant for the purposes of general housekeeping and radiological control.

The loading of compressible and non-compressible waste is conducted in a manner consistent with the philosophy of volume reduction and minimization of void spacing. After completion of waste compaction and/or container loading, each container is sealed, weighed and placed in radwaste storage, pending shipment to a licensed waste disposal site or interim processor.

Liquid System Cartridge Filters

Cartridge filters can be a high radiation and/or contamination hazard, all spent filter removals are performed under health physics surveillance. Filters are placed in an approved, appropriate shipping container (e.g., high integrity container or HIC). The HIC is then placed in storage for decay until shipment.

Liquid system cartridge filters may be placed in a HIC with spent filter media or resin for packaging efficiency.

Spent Resin – Primary System

Spent resins being prepared for direct disposal from primary systems are transferred from the Spent Resin Storage Tank to an appropriate disposal container in accordance with approved plant procedures. Normally transfer is to an HIC; however, a carbon steel container may be used provided radioactive material levels meet the criteria for Class A waste per the requirements of 10 CFR 61.55. After transfer to a disposable container, the container is dewatered in accordance with vendor-approved procedures that have been specifically developed for the dewatering of resins for the applicable vendor-supplied container. The specifics of the dewatering process must adequately demonstrate the removal of essentially all free

standing water (i.e., meeting the free standing liquids requirements of 10 CFR 61.56). Additional administrative controls taken to assure the proper dewatering of resin utilized vendor-supplied procedures and equipment are addressed in
Section IV.

Filter Media and Spent Resin – Miscellaneous Waste Monitor Tank Influent Processing

Liquid radwaste from the miscellaneous waste drain tank or the detergent waste drain tank is processed when necessary through an in-plant system provided for that purpose. The system consists of a combination of sluiceable resin vessels and mechanical filter vessels. The resin is transferred from the miscellaneous liquid waste demineralizer to an appropriate disposal container. The disposal container is normally a high-integrity container but a carbon steel disposal container may be used if the waste satisfies all federal, state and disposal site criteria for the use of containers that do not provide stability.

The contents of the disposal container are dewatered in accordance with approved procedures that are specific to the type and vendor of the disposal container being used.

The dewatering processes as provided by procedures must adequately demonstrate the removal of essentially all free-standing liquids (i.e., meeting the free-standing liquid requirements of 10 CFR 61.56). Additional administrative controls taken to assure the proper dewatering of resin utilizing vendor supplied procedures and equipment, are addressed in Section IV.

Low level cartridge filters may be placed in the disposal container with filter media or resin.

The pH of influents to waste processing systems is monitored to assure the potential for an exothermic reaction in the processing system resin is minimized.

Spent Resin – Condensate Polishing Demineralizer Holdup Tanks

The processing of resin slurries from the condensate polishing demineralizer holdup tanks is performed by an offsite processor. After transfer to an appropriate shipping container, gross dewatering is performed to meet shipping requirements.

Spent Resin – Potential Exothermic Reactions

Since we are not solidifying at Davis-Besse, exothermic reactions which could potentially occur during the solidification process would not be a consideration. If, in the future, a solidification process is used, an appropriate time will be allowed before solidifying to avoid any pressure extremes in the closed container or matrix.

Visual and/or temperature monitoring is used during the dewatering of spent resins to detect any chemical or biological reactions.

IV. GENERAL PACKAGING REQUIREMENTS FOR WASTE SHIPPED FOR DISPOSAL

Any waste that is packaged for direct disposal shall be packaged such that the disposal container is filled to a minimum of 85% of capacity and void spaces are minimized.

Process knowledge and administrative controls shall be used to ensure that waste packaged for direct disposal meets the requirements of 10 CFR 61.56 with regard to the generation of toxic or explosive gases and the exclusion of untreated hazardous materials.

V. USE OF CONTRACTOR FOR WASTE PROCESSING

Contractor-supplied services may be used at Davis-Besse for the processing of radioactive waste, including miscellaneous radwaste liquids, oil waste, and other types of waste resulting from both routine and non-routine operations. For the operation of such processing systems, it is desirable to use process control measures and procedures developed by the contractor specifically for the system. Therefore, previously addressed process control measures for a particular waste stream may, as appropriate, be superseded by contractor-supplied measures. The following discussion addresses the administrative controls that are imposed to assure that contractor-supplied systems and services for processing radioactive waste for disposal at a burial site are compatible with plant operations, procedures and regulatory requirements.

Prior to the use of any contractor for the processing of waste at Davis-Besse,, a management review of the contractor's process controls and operating procedure is performed for the purpose of assuring safe operation in accordance with plant procedures and applicable regulatory requirements. For the processing of waste that is intended to be shipped

for disposal at a licensed radioactive waste burial site, additional precautions are taken to assure a final waste product that meets the appropriate waste characteristic requirements for solidification or dewatering. In particular, the following items, as applicable, are to be documented by the contractor (or Davis-Besse manuals or procedures) prior to utilization for solid waste processing:

- a general description of the solidification process, including type of solidification agent, major process equipment and interface with plant equipment, type of wastes that can be processed, and operating parameters.
- A process control program that provides for the verification of the generation of a suitable waste product, including such items as representative sampling, laboratory tests to establish waste-to-process medium ratios, and criteria for evaluating acceptability of the final waste product.

If any test specimen fails to verify dewatering/solidification, the dewatering/ solidification of that batch under test shall be suspended. Alternate dewatering/solidification parameters can then be determined. If a subsequent test verifies dewatering/solidification, dewatering/solidification of the batch may then be resumed using the alternative parameters.

If a second test specimen fails to verify dewatering/solidification, testing of a representative specimen of the same type wet waste from consecutive batches shall be performed until at least 3 consecutive test specimens demonstrate dewatering/solidification. This Process Control Program shall be modified as required, as provided in Technical Specification 6.14, to assure solidification of subsequent batches of waste.

VI. Major Changes to Radioactive Solid Waste Treatment Systems

Licensee initiated major changes to the solid radioactive waste system:

1. Shall be reported to the Commission in the update to the Safety Analysis Report. The discussion of each change shall contain:
   a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR Part 50.59;
   b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

c. A detailed description of the equipment, components and processes involved and the interfaces with other plant systems;

d. An evaluation of the change, which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

e. An evaluation of the change, which shows the expected maximum exposures to the individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

f. A comparison of the predicted releases of radioactive materials in solid waste, to the actual releases for the period prior to when the changes are to be made;

g. An estimate of the exposure to plant operating personnel as a result of the change; and

h. Documentation of the fact that the change was reviewed and found acceptable by the Station Review Board.

2. Shall become effective upon review and acceptance by the Station Review Board.

VII. Definitions

1. DEWATERING the conversion of wet radioactive wastes into a form that meets destination waste disposal site criteria by removal of freestanding water through physical processes.

2. GROSS DEWATERING the removal of water from wet radioactive wastes to meet DOT shipping requirements and any processor's waste acceptance criteria.

3. PROCESS CONTROL PROGRAM (PCP) details the sampling, analysis, and evaluation from which SOLIDIFICATION or DEWATERING radioactive wastes from liquid systems is assured.

4. SOLIDIFICATION the conversion of wet radioactive wastes into a form that meets destination waste disposal site criteria by removal of freestanding water through chemical processes.

DAVIS-BESSE

OFFSITE DOSE CALCULATION MANUAL

Revision 12.0

Approval:

Robert B Crouse

SRB Chairman

3/3/99

Date

J H Clark

Plant Manager

3/5/99

Date