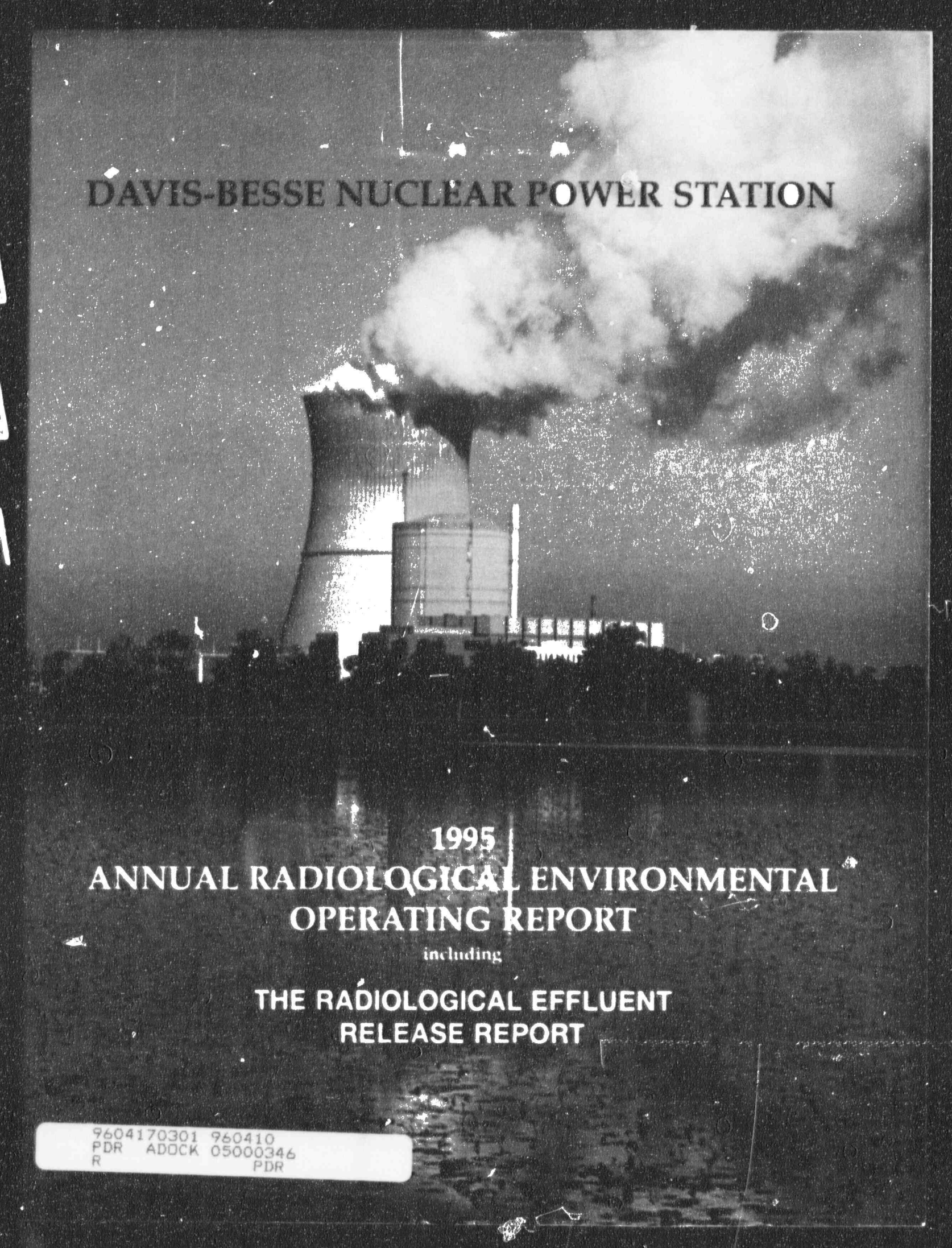
DAVIS-BESSE NUCLEAR POWER STATION

1995 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

including

THE RADIOLOGICAL EFFLUENT RELEASE REPORT

9604170301 960410
PDR ADOCK 05000346
R PDR



DAVIS-BESSE NUCLEAR POWER STATION

1995 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

including

THE RADIOLOGICAL EFFLUENT RELEASE REPORT

9604170301 960410
PDR ADOCK 05000346
R PDR

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

for

Davis-Besse Nuclear Power Station
January 1, 1995 through December 31, 1995

Prepared by:
Radiation Protection Section
Davis-Besse Nuclear Power Station
Toledo Edison Company
Toledo, Ohio

April 1996

TABLE OF CONTENTS

Title	Page
List of Tables	iv
List of Figures	vi
Executive Summary	viii
INTRODUCTION	
Fundamentals	1
Radiation and Radioactivity	2
Interaction with Matter	3
Quantities and Units of Measurement	5
Sources of Radiation	7
Health Effects of Radiation	9
Health Risks	10
Benefits of Nuclear Power	11
Nuclear Power Production	11
Station Systems	16
Reactor Safety and Summary	19
Radioactive Waste	19
Description of the Davis-Besse Site	22
References	24
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM	
Introduction	26
Preoperational Surveillance Program	26
Operational Surveillance Program Objectives	27
Quality Assurance	27
Program Description	28
Sample Analysis	32
Sample History Comparison	35

Title	Page
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (continued)	
1995 Program Deviations	37
Atmospheric Monitoring	39
Terrestrial Monitoring	45
Aquatic Monitoring	57
Direct Radiation Monitoring	68
Conclusion	79
References	80
RADIOACTIVE EFFLUENT RELEASE REPORT	
Protection Standards	83
Sources of Radioactivity Released	83
Processing and Monitoring	84
Exposure Pathways	85
Dose Assessment	86
Results	87
Regulatory Limits	88
Effluent Concentration Limits	89
Average Energy	89
Measurements of Total Activity	89
Batch Releases	90
Sources of Input Data	91
Doses to Public Due to Activities Inside the Site Boundary	91
Inoperable Radioactive Effluent Monitoring Equipment	92
Changes to The ODCM and PCP	92
Borated Water Storage Tank Radionuclide Concentration	92
LAND USE CENSUS	
Program Design	110
Methodology	110
Results	111

Title	Page
NON-RADIOLOGICAL ENVIRONMENTAL PROGRAMS	
Meteorological Monitoring	116
Land and Wetlands Management	142
Water Treatment	145
Chemical Waste Management	150
Waste Minimization and Recycling	154
APPENDICES	
Appendix A: Interlaboratory Comparison Program Results	155
Appendix B: Data Reporting Conventions	190
Appendix C: Effluent Concentration Limit of Radioactivity in Air and Water Above Natural Background in Unrestricted Areas	193
Appendix D: REMP Sampling Summary	195

List of Tables

Title	Table Number	Page Number
Risk Factors: Estimated Decrease in Average Life Expectancy	1	10
Sample Codes and Collection Frequencies	2	30
Sample Collection Summary	3	31
Radiochemical Analyses Performed on REMP Samples	4	33
Air Monitoring Locations	5	41
Milk Monitoring Location	6	46
Groundwater Monitoring Locations	7	48
Broad Leaf Vegetation and Fruit Locations	8	49
Animal/Wildlife Feed Locations	9	50
Wild and Domestic Meat Locations	10	51
Soil Locations	11	53
Treated Surface Water Locations	12	58
Untreated Surface Water Locations	13	61
Shoreline and Bottom Sediment Locations	14	62
Fish Locations	15	64
Thermoluminescent Dosimeter Locations	16	70
Gaseous Effluents - Summation of All Releases	17	93
Gaseous Effluents - Ground Level Releases - Batch Mode	18	94
Gaseous Effluents - Ground Level Releases - Continuous Mode	18	95
Gaseous Effluents - Mixed Mode Releases - Batch Mode	19	97
Gaseous Effluents - Mixed Mode Releases - Continuous Mode	19	98
Liquid Effluents - Summation of All Releases	20	100
Liquid Effluents - Nuclides Released - Batch Releases	21	101
Liquid Effluents - Nuclides Released - Continuous Releases	21	103
Solid Waste and Irradiated Fuel Shipments	22	105
Doses Due to Gaseous Releases for January through December 1995	23	107
Doses Due to Liquid Releases for January through December 1995	24	108
Annual Dose to The Most Exposed Member of The Public	25	109
Closest Exposure Pathways Present in 1995	26	113
Pathway Locations and Corresponding Atmospheric Dispersion (X/Q) and Deposition (D/Q) Parameters	27	115

Title	Table Number	Page Number
Summary of Meteorological Data Recovery for 1995	28	122
Summary of Meteorological Data Measured for 1995	29	123
Joint Frequency Distribution by Stability Class	30	137

List of Figures

Description	Figure Number	Page Number
The Atom	1	1
Principal Decay Scheme of the Uranium Series	2	3
Range and Shielding of Radiation	3	4
Sources of Exposure to the Public	4	8
Fission Diagram	5	12
Fuel Rod, Fuel Assembly, Reactor Vessel	6	13
Schematics of DBNPS	7	15
Dry Fuel Storage Module Arrangement	8	21
Map of Area Surrounding Davis-Besse	9	22
Airborne Particulate: Gross Beta	10	40
Airborne Sampling Locations on Davis-Besse Site	11	42
Airborne Sampling Locations within a Five Mile Radius	12	43
Airborne Sampling Locations within a Twenty-Five Mile Radius	13	44
Groundwater Samples: Gross Beta	14	47
Soil Samples: Cesium-137	15	52
Terrestrial Sampling Locations on Davis-Besse Site	16	54
Terrestrial Sampling Locations within a Five Mile Radius	17	55
Terrestrial Sampling Locations within a Twenty-Five Mile Radius	18	56
Treated Surface Water Samples: Gross Beta	19	58
Untreated Surface Water Samples: Gross Beta	20	60
Fish Samples: Gross Beta	21	63
Aquatic Sampling Locations on Davis-Besse Site	22	65
Aquatic Sampling Locations within a Five Mile Radius	23	66
Aquatic Sampling Locations within a Twenty-Five Mile Radius	24	67
TLD Dose Comparison 1973 - 1995	25	69
Comparison of NRC and Davis-Besse TLDs	26	70
Direct Radiation Sampling Locations on Davis-Besse Site	27	76
Direct Radiation Sampling Locations within a Five Mile Radius	28	77
Direct Radiation Sampling Locations within a Twenty-Five Mile Radius	29	78
Exposure Pathways	30	86

Description	Figure Number	Page Number
Land Use Census Map	31	112
Wind Rose Annual Average 100M	32	125
Wind Rose Annual Average 75M	33	126
Wind Rose Annual Average 10M	34	127
Wind Rose Monthly Average 100M	35	128
Wind Rose Monthly Average 75M	36	131
Wind Rose Monthly Average 10M	37	134
Water Treatment Plant Schematic	38	146

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, 1995. 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, Marsh 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, 1995.

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 Offsite Dose Calculation Manual 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, egg, fruit and vegetables, animal feed, soil, drinking water, surface water, fish, bottom and 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 1995. An explanation for the sample program deviations for this reporting period is provided on page 38.

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 and the filters are collected to monitor the atmosphere. The 1995 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. The results of the analyses of the terrestrial samples indicate concentrations of radioactivity similar to previous years and indicates no build-up of radiation due to the operation of Davis-Besse.

- Aquatic monitoring includes the collection and analysis of drinking water, untreated surface water, fish and shoreline sediments. The 1995 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 13.0 ± 2.6 mrem/91days at indicator locations and 14.2 ±2.2 mrem/91 days at control locations. This is similar to results of previous years.

The operation of Davis-Besse in 1995 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 1995 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, and is called the critical pathway. The critical pathway for 1995 is a garden located 880 meters north-northeast of the plant.

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, 1995 through December 31, 1995. The doses due to radioactivity released during this period were estimated to be:

Liquid Effluents:

Maximum Individual Whole Body Dose	1.03E-01 mrem (0.103 mrem)
Maximum Individual Significant Organ Dose	1.35E-01 mrem (0.135 mrem)
Total Integrated Population Dose	3.63E+00 person- rem (3.36 person-rem)
Average Dose to the Individual	1.66E-03 mrem (0.00166 mrem)

Gaseous Effluents:

Maximum Individual Whole Body Dose due to I-131, H-3 and Particulates with half-lives greater than 8 days	3.94E-03 mrem (0.00394 mrem)
Maximum Significant Organ dose due to I-131, H-3 and Particulates with half-lives greater than 8 days	1.70E-02 mrem (0.017 mrem)
Total Integrated Population dose due to I-131, H-3 and Particulates with half-lives greater than 8 days	5.06E-03 person-rem (0.00506 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	2.32E-06 mrem (0.00000232 mrem)
Maximum Individual Skin dose due to noble gases	1.34E-02 mrad (0.0134 mrad)
Maximum Individual Whole Body Dose due to noble gases	3.52E-03 mrad (0.00352 mrad)
Total Integrated Population dose due to noble gases	8.24E-03 person-rem (0.00824 person-rem)
Average dose to individual in population due to noble gases	3.77E-06 mrem (0.00000377 mrem)

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

There were no abnormal liquid releases and no abnormal gaseous release during this reporting period.

There were no changes to the Process Control Program (PCP) during this reporting period. There were two changes to the Offsite Dose Calculation Manual 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 instruments are monitored by trained personnel.

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 six instruments required to be operational by Davis-Besse Technical Specifications was 99.3%.

♦ 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. Davis-Besse personnel are responsible for inspecting the marsh and reporting on its status monthly.

Special projects conducted in 1995 with the cooperation of Ohio Department of Natural Resources included Canada goose banding, a Volunteer Eagle Watch Workshop, International Migratory Bird Day and a Waterfowl Identification Seminar. During 1995, 10 acres of land outside the marsh has been planted with prairie grass and wild flowers. This will provide habitat for upland animals, improve water quality, and reduce soil erosion. Also, Davis-Besse pledge partnership with Ducks Unlimited, the Ohio Division of Wildlife and Ottawa National Wildlife Refuge in restoring 908 acres of wetland in Metzers Marsh.

For the first time in Davis-Besse history, a young eaglet was fledged in our marsh. The eaglet was one of 38 eaglets fledged in Ohio in 1995.

♦ Water Treatment

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

Toledo Edison personnel collected and analyzed water samples from various locations on the station as part of the Zebra Mussel Control Program. Results show that the mussel population appears to be leveling off or declining slightly, mostly due to the increasing clarity of Lake Erie.

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. Two comminutors were purchased and installed to grind and shred incoming material and reduce clogging of the surge tank pumps.

♦ Chemical Waste Management

The Chemical Waste Management Program at Davis-Besse was developed to ensure that the offsite 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 1995, the Davis-Besse Nuclear Power Station generated 1,620 pounds of hazardous wastes, which represents a 74% reduction from 1994. There were 3,070 gallons of non-hazardous waste oil generated in 1995, a 32% reduction from 1994. Additionally, approximately 1,200 gallons of oil filters and solid oily debris were generated.

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. Throughout 1995, a total of 58 tons of paper were collected and recycled and 9 tons of cardboard were collected that would have otherwise been disposed of in a landfill. The scrap metal collected onsite was 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 1995.

Appendix D provides a REMP sampling summary from 1995. 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 (March 1995).

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 consist 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.

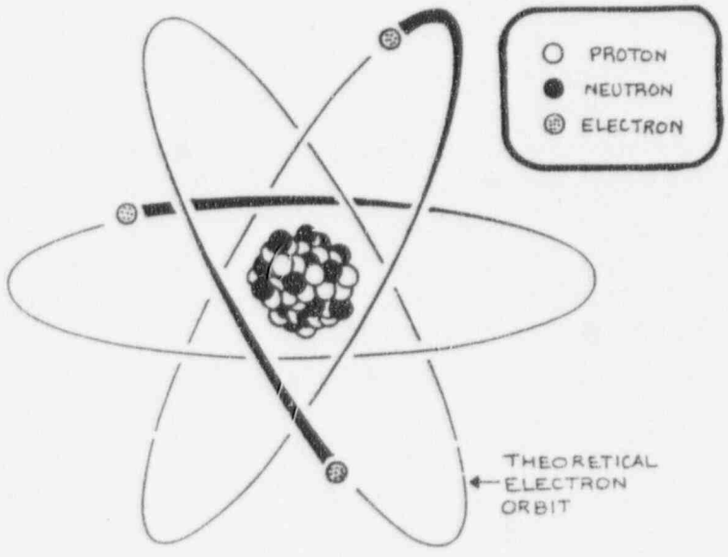


Figure 1: An atom consists of two parts: a nucleus containing positively charged protons and electrically neutral neutrons and one or more negatively charged electrons orbiting the nucleus. Protons and neutrons are nearly identical in size and weight, while each is about 2000 times heavier than an electron.

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 manmade, 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).

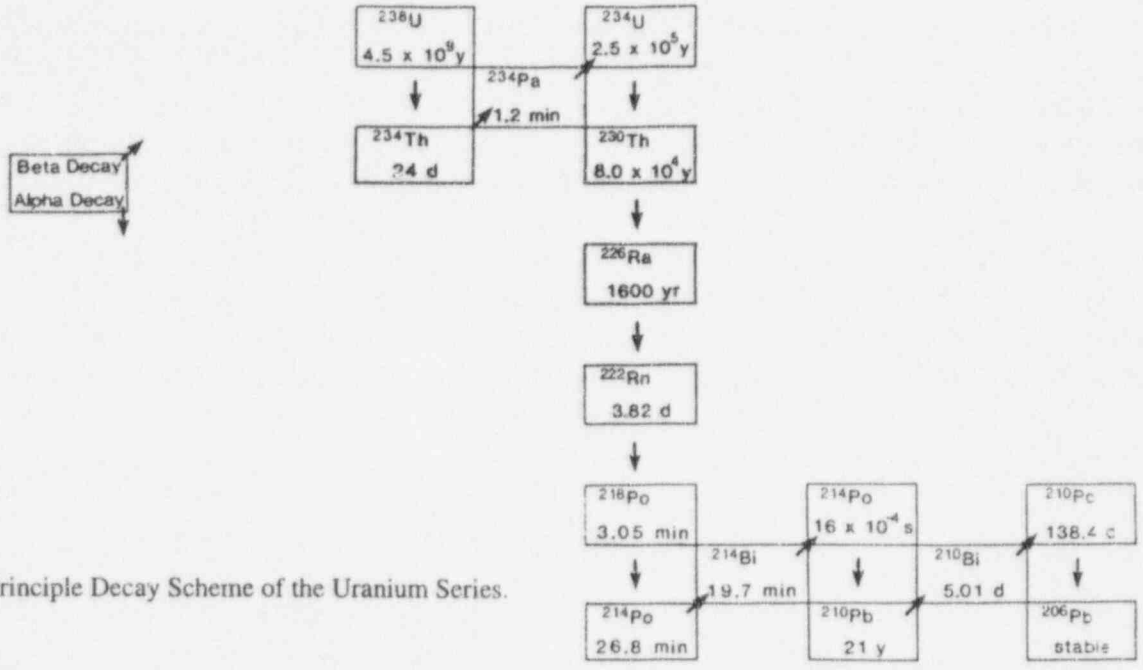


Figure 2: Principle Decay Scheme of the Uranium Series.

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.

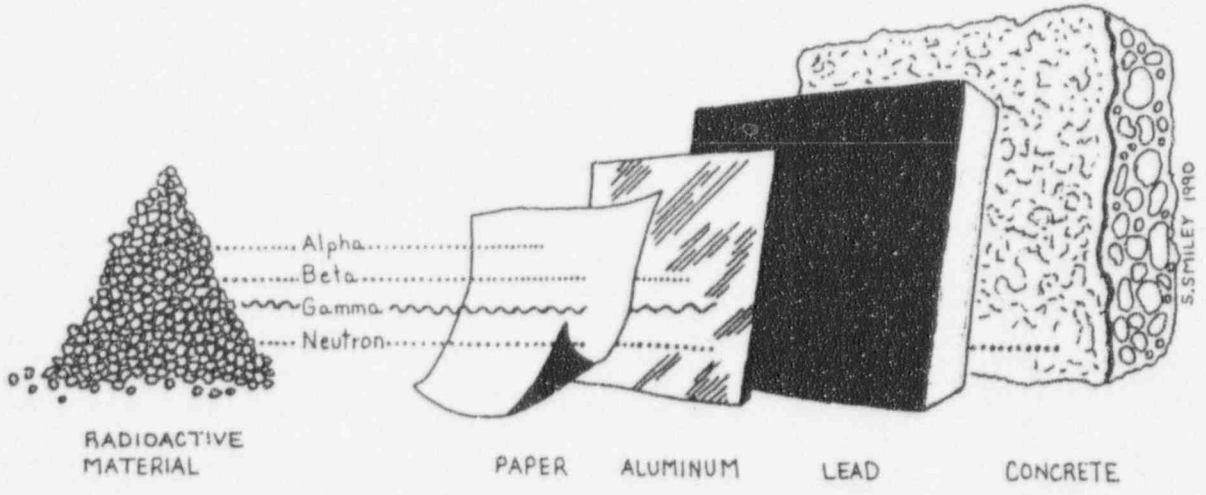


Figure 3: As radiation travels, it collides and interacts with other atoms and loses energy. Alpha particles can be stopped by a sheet of paper, and beta particles by a thin sheet of aluminum. Gamma radiation is shielded by highly dense materials such as lead, while hydrogenous materials (those containing 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 radiations. 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 deep dose equivalent (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.

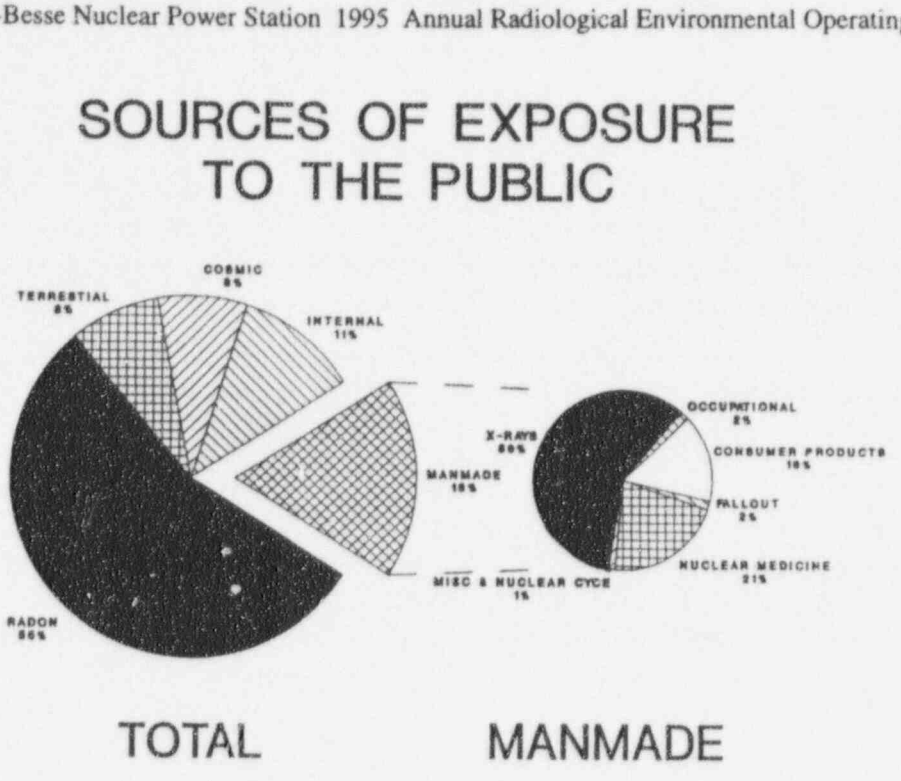


Figure 4: The most significant annual dose received by an individual of the public is that received from naturally occurring radon. A very small annual dose to the public results from producing electricity by nuclear power.

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.

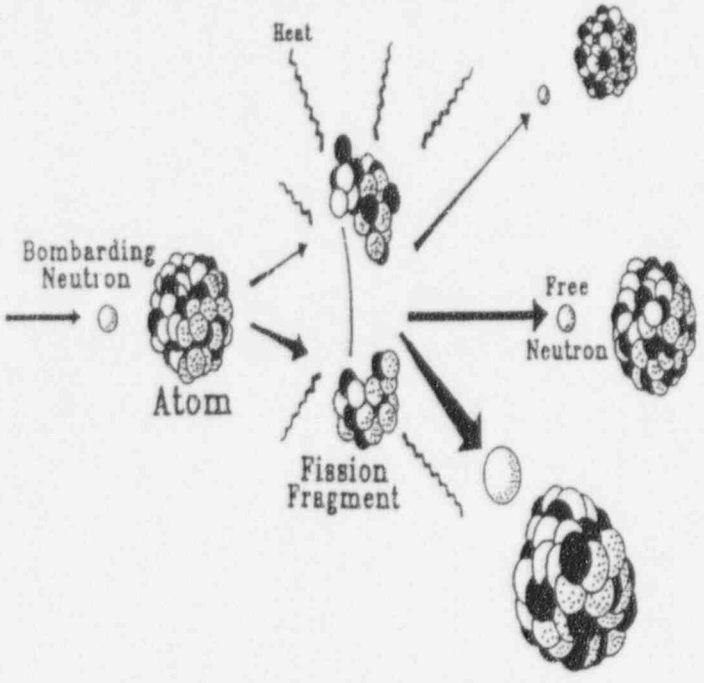


Figure 5: When a heavy atom, such as uranium-235 is split or fissioned, heat, free neutrons, and fission fragments result. The free neutrons can then strike neighboring atoms causing them to fission also. In the proper environment, this process can continue indefinitely in a chain reaction.

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 (UO2)**, 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.

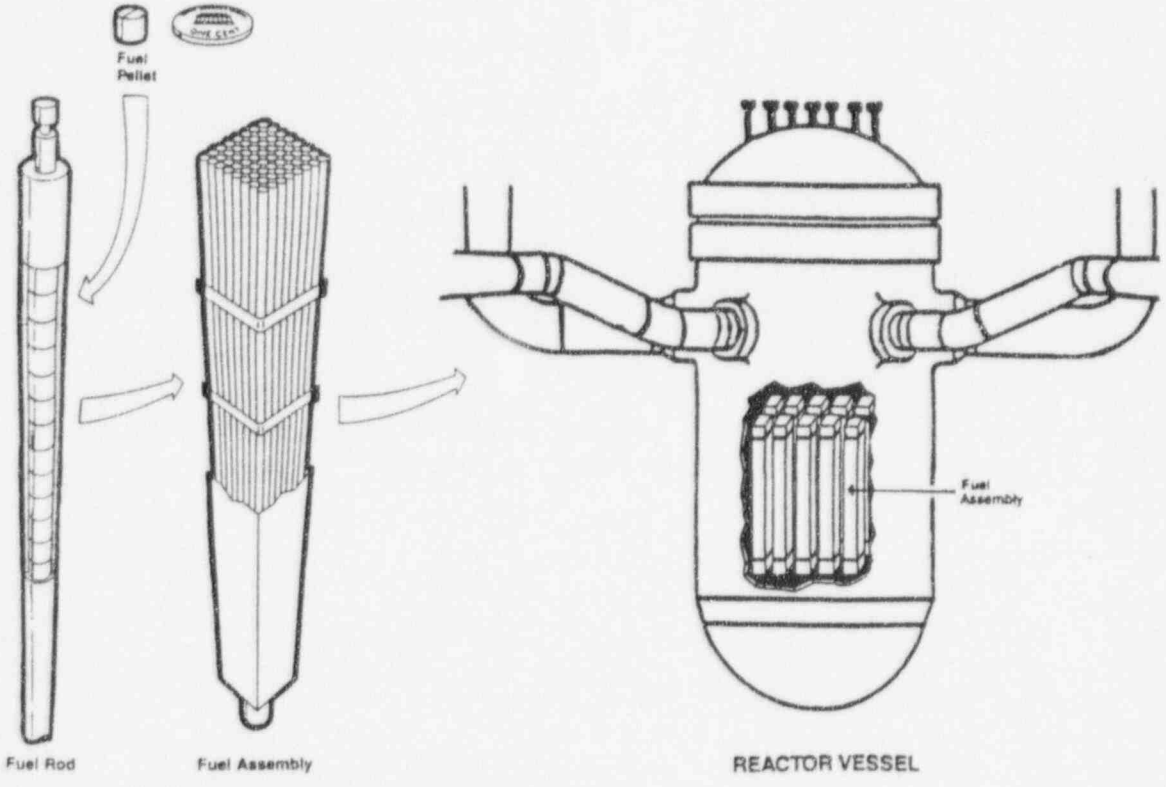


Figure 6: The reactor core at Davis-Besse contains 177 fuel assemblies. Each assembly contains 208 fuel rods. Each fuel rod is filled with approximately five pounds of fuel pellets, each pellet is approximately 3/8 inch in diameter and 5/8 inch long.

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

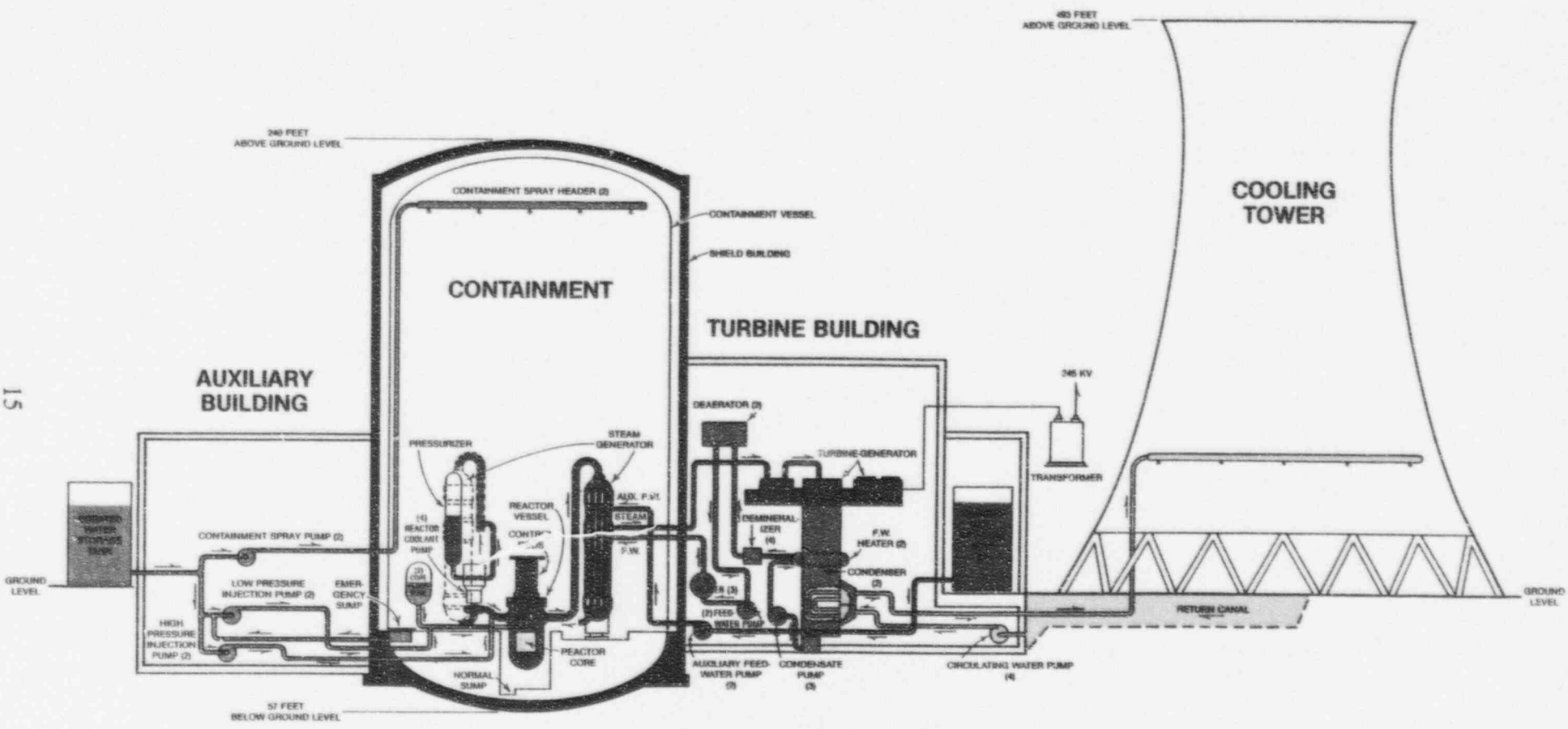
Virtually all of the commercial reactors in this country are either **boiling water reactors (BWRs)** or **pressurized water reactors (PWRs).** Both types are also called **light water reactors (LWRs)** because their coolant, or medium to transfer heat, is ordinary water, which contains the light isotope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

Davis-Besse Nuclear Power Station
Unit No. 1



GREEN - Reactor Coolant System (Primary Coolant Water)

RED - Main Steam System

BLUE - Condensate/Main Feedwater System (Secondary Coolant Water)

YELLOW - Circulating Water System (Tertiary Coolant Water)

ORANGE - Emergency Core Cooling System

SCARLET - Auxiliary Feedwater System

VIOLET - Pressurizer and Associated Structures

Figure 7

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 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 inadequate. 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.

In 1980, Congress passed the Low-Level Waste Policy Act. This law requires each state to develop an individual disposal site for waste, or to form "compacts" with other states to jointly dispose of their low-level waste. Approximately 10 regional compacts have been formed.

Ohio is a member of the Midwest Compact, which includes Indiana, Iowa, Missouri, Minnesota, and Wisconsin. Since Ohio is the largest producer of low-level waste in the Compact, it has the responsibility to site the first disposal facility, which would receive waste from all Compact states for 20 years. The responsibility then shifts to the Compact's next largest producer of waste, Minnesota, which will host the repository for the second 20 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, 1995. The facility was reopened by South Carolina to all generators on July 1, 1995. 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. Low level waste will be shipped to a Midwest Compact facility when one becomes operational.

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 18 to 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 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 1995. At the end of 1995, 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 Colorado, Maryland, Virginia, and South Carolina. Figure 8 illustrates the dry fuel storage module arrangement at Davis-Besse.

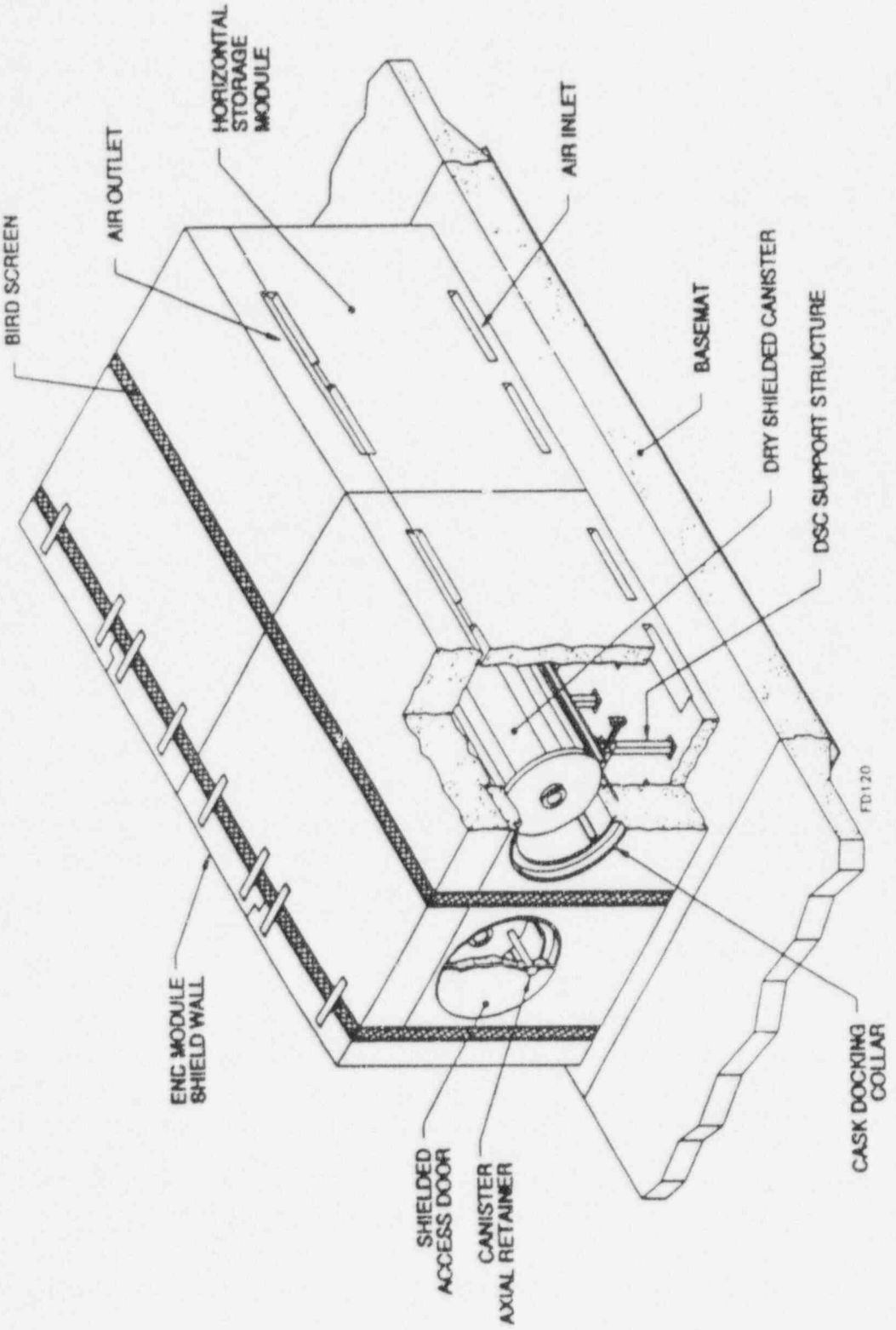


Figure 8: Dry Fuel Storage Module

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.

References

1. "Basic Radiation Protection Criteria," Report No. 39, National Council on Radiation Protection and Measurement, Washington, D.C. (January 1971).

2. "Cesium-137 from the Environment to Man: Metabolism and Dose," Report No. 52, National Council on Radiation Protection and Measurements, Washington, D.C. (January 1977).

3. Deutch, R., "Nuclear Power, A Rational Approach," Fourth edition, GP Courseware, Inc., Columbia, MD. (1987).

4. Eisenbud, M., "Environmental Radioactivity," Academic Press, Inc., Orlando, FL. (1987).

5. "Environmental Radiation Measurements," Report No. 50, National Council on Radiation Protection and Measurements, Washington, D.C. (December 1976).

6. "Exposure of the Population in the United States and Canada from Natural Background Radiation," Report No. 94, National Council on Radiation Protection and Measurements, Washington, D.C. (December 1987).

7. "Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR V," Committee on the Biological Effects of Ionizing Radiations, Board on Radiation Effects Research Commission on Life Sciences, National Research Council, National Academy Press, Washington, D.C. (1990).

8. Hendee, William R., and Doege, Theodore C., "Origin and Health Risks of Indoor Radon," Seminars in Nuclear Medicine, Vol. XVIII, No. 1, American Medical Association, Chicago, IL. (January 1987).

9. Hurley, P., "Living with Nuclear Radiation," University of Michigan Press, Ann Arbor, MI. (1982).

10. "Indoor Air Quality Environmental Information Handbook: Radon," prepared for the United States Department of Energy, Assistant Secretary for Environment, Safety and Health, by Mueller Associated, Inc., Baltimore, MD. (January 1986).

11. Introduction to Davis-Besse Nuclear Power Station Plant Technology, July 1992, Rev. 4, Pg.2-9.

12. "Ionizing Radiation Exposure of the Population of the United States," Report No. 93, National Council on Radiation Protection and Measurements, Washington, D.C. (September 1987).

13. "Natural Background Radiation in the United States," Report No. 45, National Council on Radiation Protection and Measurements, Washington, D.C. (November 1975).

14. "Nuclear Energy Emerges from 1980's Poised for New Growth," U.S. Council for Energy Awareness, Washington, D.C. (1989).

15. "Nuclear Power: Answers to Your Questions," Edison Electric Institute, Washington, D.C. (1987).

16. "Public Radiation Exposure from Nuclear Power Generation in the United States," Report No. 92, National Council on Radiation Protection and Measurement, Washington, D.C. (December 1987).

17. "Radiation Protection Standards," Department of Environmental Sciences and Physiology and the Office of Continuing Education, Harvard School Of Public Health, Boston, MA. (July 1989).

18. Radiological Environmental Monitoring Report for Three Mile Island Station," GPU Nuclear Corporation, Middletown, PA. (1985).

19. "Sources, Effects and Risk of Ionizing Radiation," United Nations Scientific Committee on the Effects of Atomic Radiation, 1988 Report to the General Assembly, United Nations, New York (1988).

20. "Standards for Protection Against Radiation," Title 10, Part 20, Code of Federal Regulation, Washington, D.C. (1988).

21. "Domestic Licensing of Production and Utilization Facilities," Title 10, Part 50, Code of Federal Regulations, Washington, D.C. (1988).

22. "Environmental Radiation Protection Standard for Nuclear Power Operations," Title 40, Part 190, Code of Federal Regulations, Washington, D.C. (1988).

23. "Tritium in the Environment," Report No. 62, National Council on Radiation Protection and Measurement, Washington, D.C. (March 1979).

24. Site Environmental Report, Fernald Environmental Management Project, U.S. Department of Energy (June 1993).

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;
- 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.

QA 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 Quality Assurance 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 either 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 radioiodine

- **terrestrial** -- including samples of milk, groundwater, broad leaf vegetation, fruits animal/wildlife feed, soil, eggs, and wild and domestic meat
- **aquatic** -- including samples of treated and untreated surface water, fish, and shoreline and bottom 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. Over 1700 samples were collected and over 2350 analyses were performed during 1995. 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
Broad Leaf Vegetation	BLV	Monthly (when available)
Surface Water - Treated	SWT	Weekly
Surface Water - Untreated	SWU	Weekly
Fish	FIS	Semiannually
Shoreline/Bottom Sediment	SED	Semiannually
Soil	SOI	Semiannually
Animal/Wildlife Feed	DFE/WFE	Annually
Meat-Domestic	DME	Annually
Meat-Wild	WME	Annually
Egg	EGG	Annually
Fruits	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		10	520	0
Airborne Radioiodine	C/W	10	520	0
Terrestrial				
Milk (Jan.-Dec.)	G/M	1	12	0
Groundwater	G/Q***	4	16	0
Edible Meat				
wild	G/A	1	0	1
domestic	G/A	2	2	0
Eggs	G/A	2	0	2
Broad Leaf				
Vegetation / Fruit	G/M	7	17	0
Soil	G/S	10	20	0
Animal/Wildlife Feed	G/A	4	4	0
Aquatic				
Treated	Comp/WM***	2	30	0
Surface Water	G/WM***	4	42	0
Untreated	G/WM***	2	17	0
Surface Water	G/M	10	60	0
	Comp/WM***	4	55	0
Fish (3 species)	G/SA	2	6	6
Shoreline Sediments	G/SA	4	8	0
Direct Radiation				
Thermoluminescent Dosimeters (TLD)	C/Q***	93	366	6
	C/A***	93	89	4

* Type of Collection: C = Continuous; G = Grab; Comp = Composite
** Frequency of Collection: WM = Weekly composited Monthly; W = Weekly
*** Includes quality control location
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 6 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
Broad Leaf 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
Egg	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.
- **Broad Leaf 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.
- **Eggs:** Only natural background radioactive material 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±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.

During 1995, trace amounts of tritium was detected in six untreated water samples collected in May and in 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 only 0.12% of the Effluent Concentration Limit of 1,000,000 pCi/l for tritium in an unrestricted area, as stated in 10 CFR 20, Appendix B, Table 2. Subsequent samples taken showed the tritium activity to be <330 pCi/l.

- **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 47.1 to 74.7 millirem per year at control locations and between 35.7 and 77.1 millirem per year at indicator locations. No increase above natural background radiation attributable to the operation of Davis-Besse has been observed.

1995 Program Deviations

Provided below is a description and explanation of 1995 environmental sample collection deviations.

- Broad leaf vegetation samples during January, February, March, April, May, June, November and December 1995 were unavailable for collection because of seasonal condition or insufficient quantity of desired broad leaf vegetation.

- The treated surface water sample from T-144 was deleted from the program in January 1995.
- On March 14, 1995, the untreated surface water sample collected at T-28 may not have been a represented composite for that sampling period. The line going to the compositor became plugged during the sampling period thus not compositing equal allotments of water. A new line was installed and the compositor returned to service.
- The first quarter and annual TLDs were discovered missing from T-80 and T-92 at the time of TLD exchange. The reason is thought to be random acts of vandalism.
- Due to bald eagle nesting activity in the vicinity of T-61 TLD, the first quarter TLD was not removed until the end of the second quarter. The dose on the TLD was reported so that equal portions was attributed to the first and second quarters.
- The second quarter and annual TLDs were discovered missing from T-66 and T-81 at the time of TLD exchange. The reason is thought to be random acts of vandalism.
- On July 11, 1995, three required continuous air monitors (T-1, T-2, and T-3) were out of service up to 4 hours due to maintenance activities.
- On July 25, 1995, the compositor at T-28 untreated surface water location malfunctioned when the intake line broke. A grab sample was collected and the compositor was repaired and returned to service.
- The third quarter and annual TLDs were discovered missing from T-155 at the time of TLD exchange. The reason is thought to be a random act of vandalism.
- On October 24, 1995 at T-4, the required LLD of <0.07 pCi/m^3 for I-131 could not be reached because of insufficient sample volume. Due to a power outage cause by severe weather, a sufficient sample volume could not be collected during the sample period. The LLD reached for this sample was <0.08 pCi/m^3.
- In October 1995, egg samples were unavailable for collection. The chickens at indicator location T-197 were not producing eggs yet. The control location T-34 did not raise egg laying varieties of chickens.
- In November 1995, the second fish collection of the year was not collected. The nets were removed from the indicator location early in the month because of low fish harvest. Weather conditions on the lake also prevented collection prior to the nets being removed.

- In December 1995, the wild meat (muskrat) sample was not collected. The lower water levels in the onsite marsh reduced the muskrat population. Samples could not be purchased from trappers of this area because a permit to trap was not issued by the U.S. Fish and Wildlife Department. Also, efforts by site personnel to trap muskrats were unsuccessful.
- The fourth quarter and annual TLDs were missing from T-112 at the time of TLD exchange. The reason is thought to be random act of vandalism.

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 (composited) 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 0.019 pCi/m^3 and 0.020 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) was not detected above its LLD of 0.0011 pCi/m^3. Strontium-90 (Sr-90)

was detected in one sample (T-2) during the second quarter at 0.002±0.0004 pCi/m^3. For comparison purposes, Sr-90 in air during the preoperational period ranged from 0.0002 pCi/l to 0.0026 pCi/l. These results show no adverse change in radioactivity in air samples due to operation of the Davis-Besse Nuclear Power Station in 1995.

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 1995, there was no detectable iodine-131 above the LLD of 0.07 pCi/m^3. On October 24, 1995, at T-4, the required LLD for I-131 could not be reached because of insufficient sample volume for that sampling period. The low volume was the result of a power outage caused by severe weather conditions. The LLD reached for this sample was <0.08 pCi/m^3.

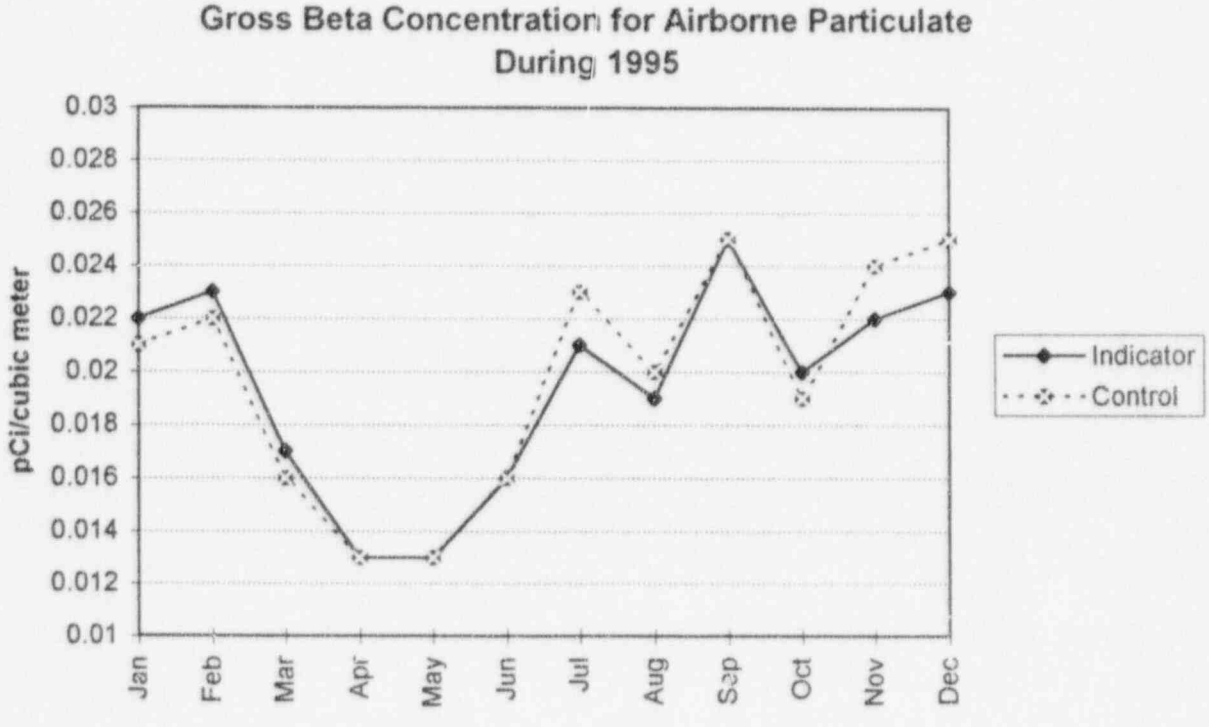


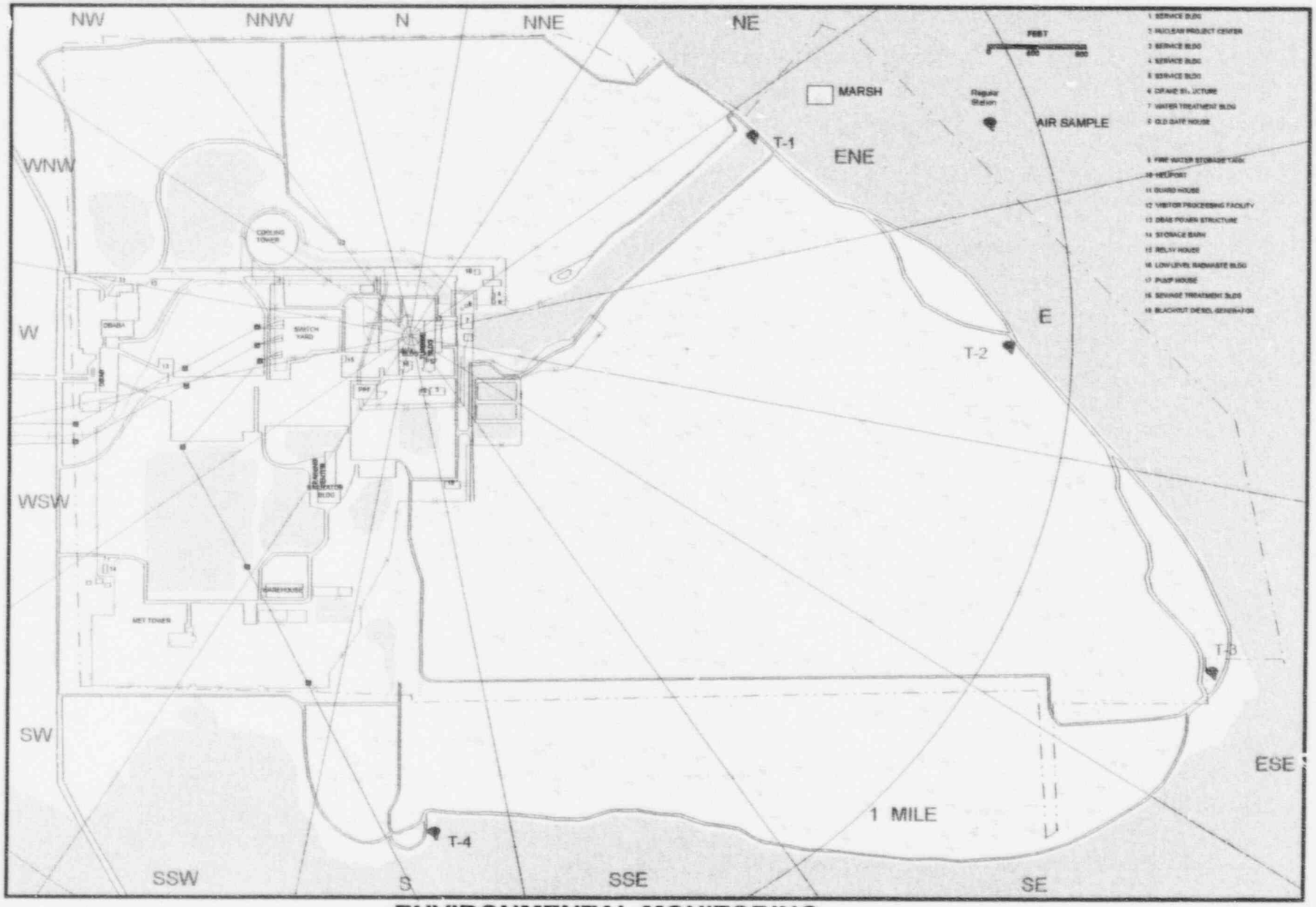
Figure 10: Concentration of beta emitting radionuclides in airborne particulates samples were essentially identical at indicator and control locations.

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

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
AIR SAMPLES: SITE



ENVIRONMENTAL MONITORING

Figure 11

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
AIR SAMPLES: 5 MILES RADIUS

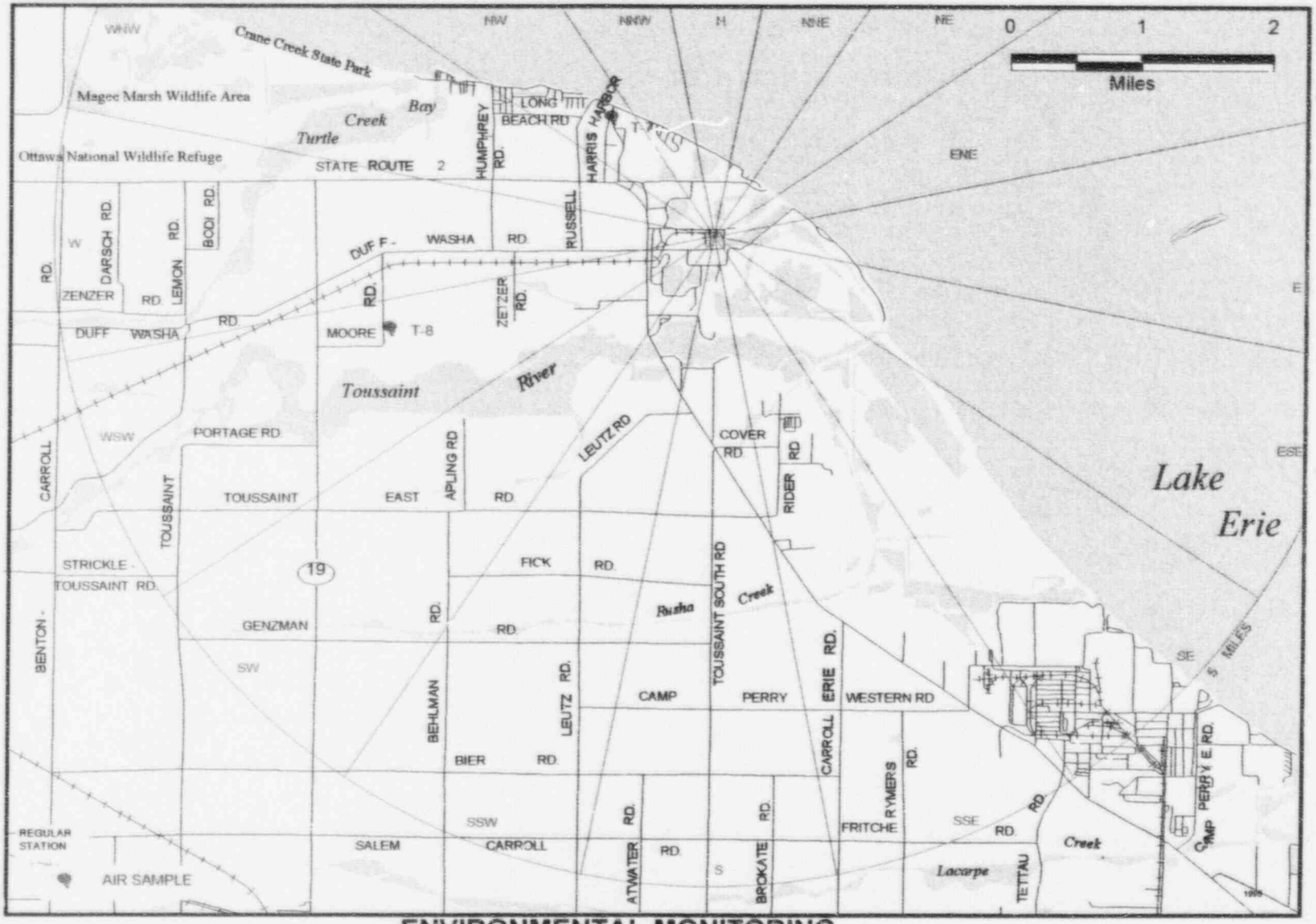
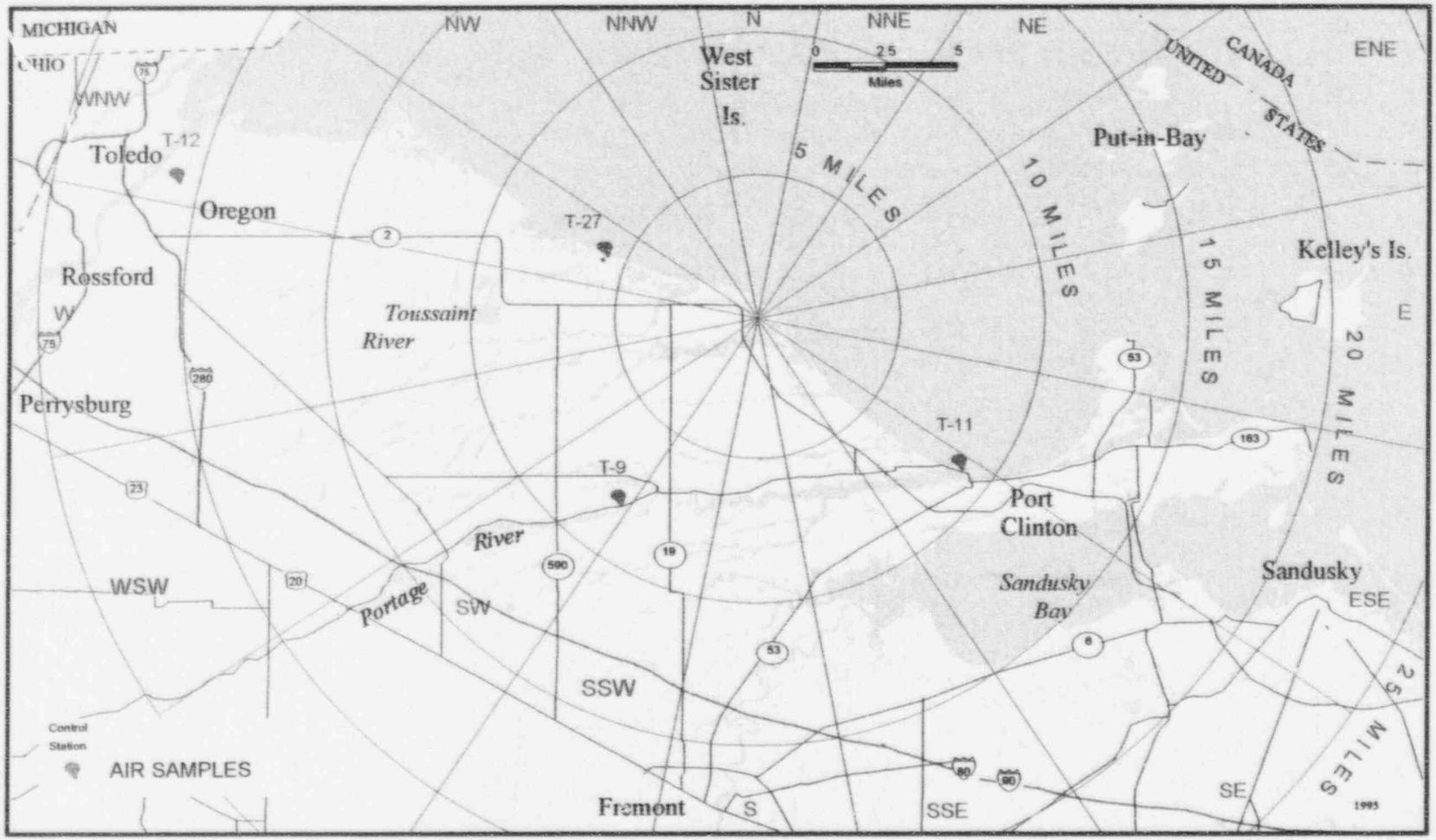


Figure 12

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
AIR SAMPLES: 5-25 MILE RADIUS



ENVIRONMENTAL MONITORING

Figure 13

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 1995 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 1995. Strontium-89 was not detected above the LLD of 0.8 pCi/l in any of the samples. Strontium-90 was detected in all samples collected. The annual average concentration of strontium-90 was 1.2 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. Although Davis-Besse does not discharge its liquid effluents directly to the ground, REMP personnel sample local wells on a quarterly basis to ensure the early detection of any adverse impact on the local groundwater supplies due to Station operation. The wells sampled include two indicator locations (T-7, T-54), and one control location (T-27). In addition, a quality control sample is collected at one of the wells each quarter. The groundwater samples are analyzed for beta emitting radionuclides, tritium, strontium-89, strontium-90 and gamma emitting radionuclides.

Beta emitting radionuclides average 3.56 pCi/l for indicator locations and 4.97 pCi/l for control locations. Tritium was not detected above the LLD of 330 pCi/ l. Strontium-89 was not detected above the LLD of 1.2 pCi/l. Strontium-90 was detected in indicator sample at an average concentration of 0.7 pCi/l. There were no gamma emitting radionuclides detected above their respective LLDs in any of the samples collected. All sample analyses were within normal ranges and were similar to results of previous years.

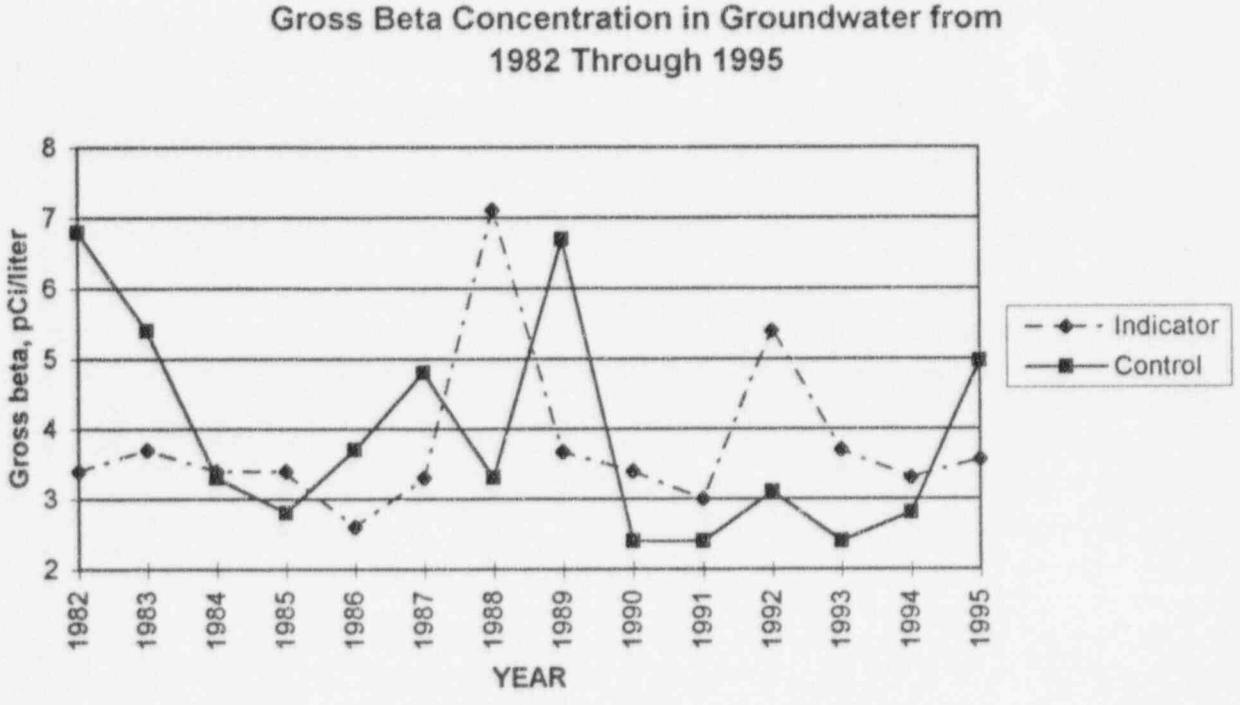


Figure 14: Shown above are the annual averages for gross beta in groundwater from 1982 - 1995. This years results are well within the range of previous years.

Table 7: Groundwater Monitoring Locations

Sample Location Number	Type of Location	Location Description
T-7	I	Sand Beach, 0.9 miles NW of Station
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

Broad Leaf Vegetation and Fruit Samples

Fruits and broad leaf vegetation also represent a direct pathway to humans. Fruits and broad leaf 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 broad leaf vegetation, such as kale and cabbage, and fruits, such as apples and grapes, are collected from farms in the vicinity of Davis-Besse.

In 1995, broad leaf 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 two control locations (T-37 and T-173). Broad leaf vegetation was collected once a month during the growing season. Broad leaf vegetation collected consisted of cabbage, kale, beet greens, chinese cabbage and broccoli. The fruits collected were apples, pears, and grapes. All samples were analyzed for gamma emitting radionuclides, strontium-89, strontium-90, and iodine-131.

Iodine-131 was not detected above the LLD of 0.028 pCi/g (wet) in any broad leaf vegetation nor above the LLD of 0.021 pCi/g (wet) in fruit samples. The only gamma emitting radionuclide detected in the fruit and broad leaf vegetation samples was potassium-40, which is naturally occurring. In both fruit and broad leaf vegetation, strontium-89 was not detected above their LLDs of 0.0065 pCi/g (wet) and 0.0067 pCi/g (wet). Strontium-90 (Sr-90) was detected at average concentrations of 0.002 pCi/g (wet) for indicator locations and 0.0014 pCi/g (wet) for control locations. In the fruit samples, Sr-90 was detected at location T-8 (indicator) at 0.0005 pCi/g and

T-173 (control) at 0.0036 pCi/gm Sr-90. 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.

Table 8: Broad Leaf 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	Centerior Energy property, 0.68 mile SW of Station
T-19	I	Hemminger Farm, 0.6 mile W of Station
T-25	I	Miller Farm, 3.7 miles S of Station
T-37	C	Bench Farm, 13.0 miles SW of Station
T-173	C	Firelands Winery, Sandusky, 20.0 miles SE of station.

I = indicator C = control

Animal/Wildlife Feed Samples

As with broad leaf 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 animal 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.

- Domestic animal feed was collected annually at chicken sampling locations. 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 two locations (T-31 and T-198). The samples consisted of the edible portions of cattails. Samples were analyzed for gamma emitting radionuclides. In both the animal and wildlife feed, only naturally occurring potassium-40 was detected. 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-34	C	Brooks farm, Graytown 8.8 miles W. of the Station
T-197	I	Priesman Farm 1.7 miles W of the Station
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 on 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) and eggs on an annual basis. Wild animals commonly consumed by residents in the vicinity of Davis-Besse include waterfowl, deer, rabbits and muskrats. Analyses from animals whose meat is eaten by humans provides 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.

Both wild and domestic meat samples and eggs were sampled in 1995 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 not obtained because lower marsh levels onsite made collecting a sample impractical.
- Eggs: Eggs were unavailable at both locations at the time of collection. T-197 chickens were not laying eggs yet and T-34 did not have any laying chickens.

Table 10: Wild and Domestic Meat Locations

Sample Location Number	Type of Location	Location Description
T-31	I	Onsite roving location
T-34	C	Brooks Farm, Graytown, 8.8 miles W. of the Station
T-197	I	Priesman Farm, 1.7 miles W of the Station

I = indicator C = control

Soil Samples

Soil samples are generally collected twice a year at the sites which 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 which are often detected include strontium-90 (Sr-90), cesium-137 (Cs-137), cerium-141 (Ce-141) and ruthenium-106 (Ru-106).

During 1995, soil was collected at ten sites in May and November. 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 0.57 and 0.40 pCi/g dry, respectively. The concentrations were similar to that observed in previous years (Figure15).

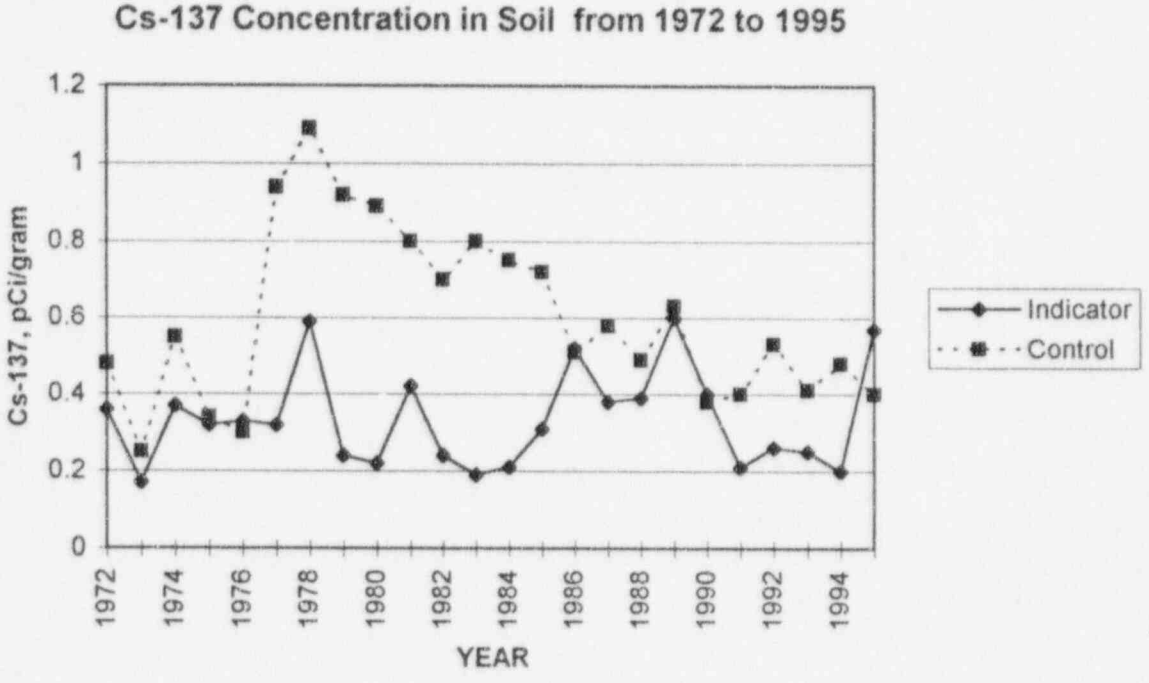


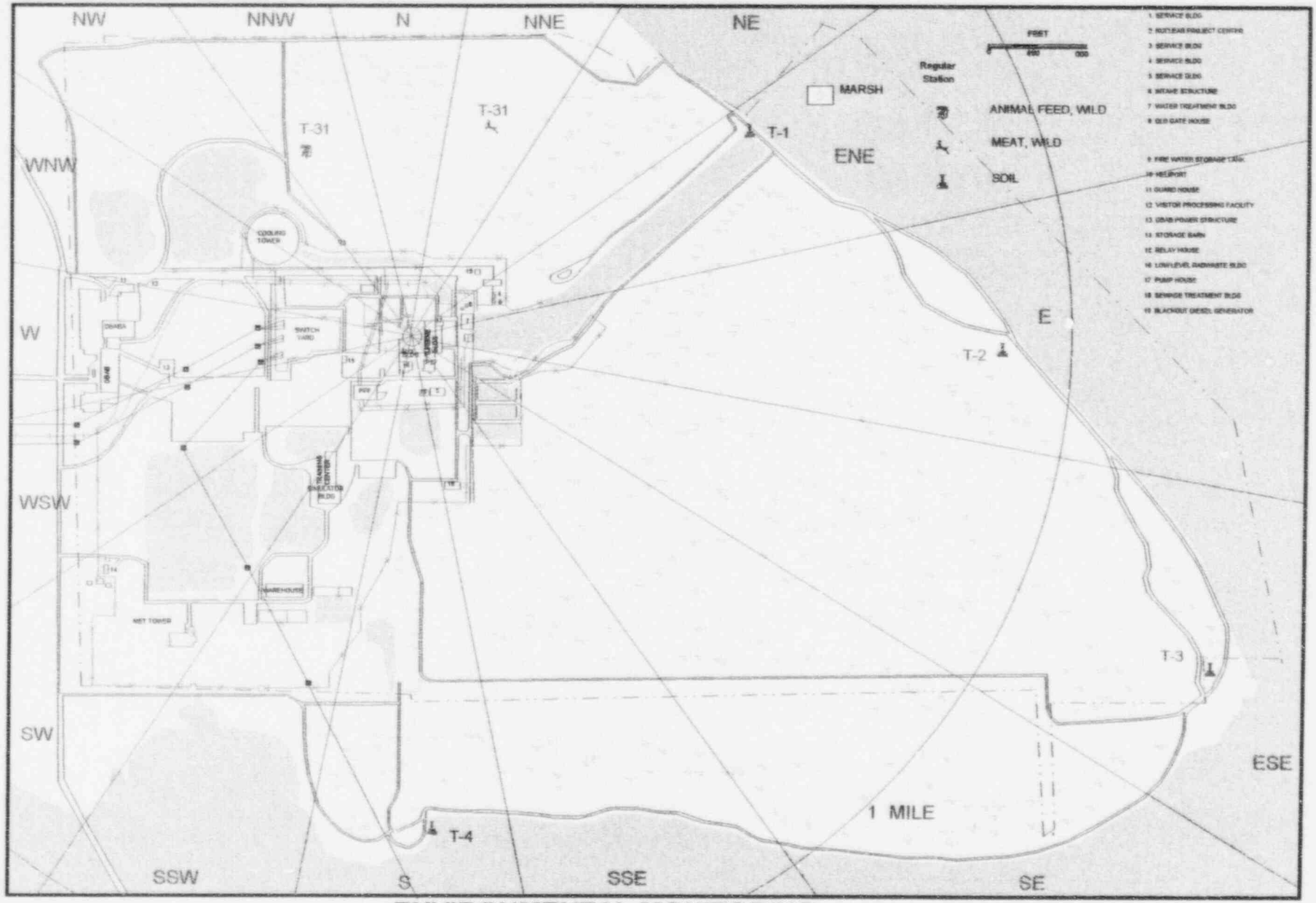
Figure 15: The concentration of cesium-137 in soil has remained fairly constant over the years REMP has been conducted. The peak seen in 1978 was due to fallout from nuclear weapons testing.

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

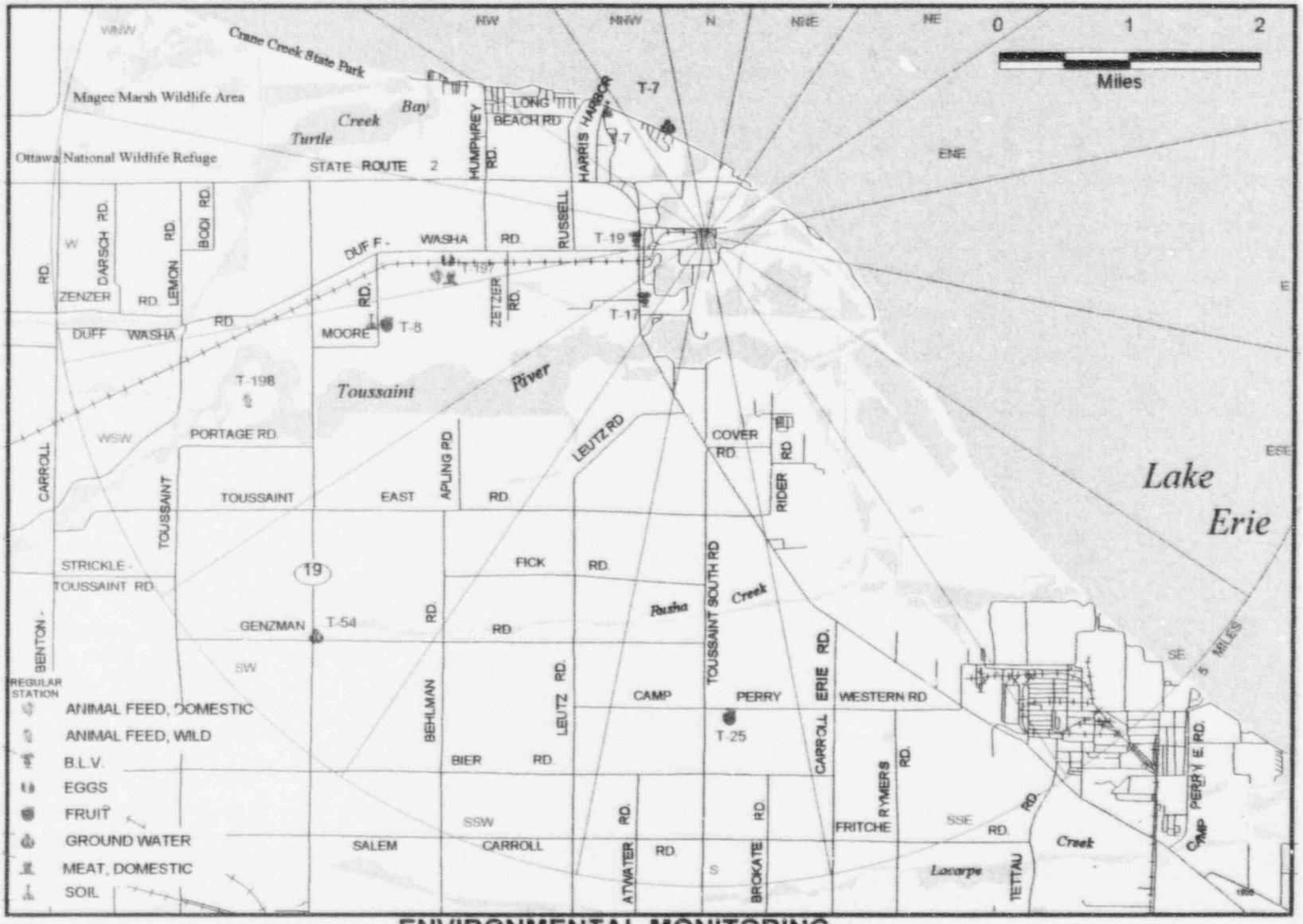
DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
TERRESTRIAL SAMPLES: SITE



ENVIRONMENTAL MONITORING

Figure 16

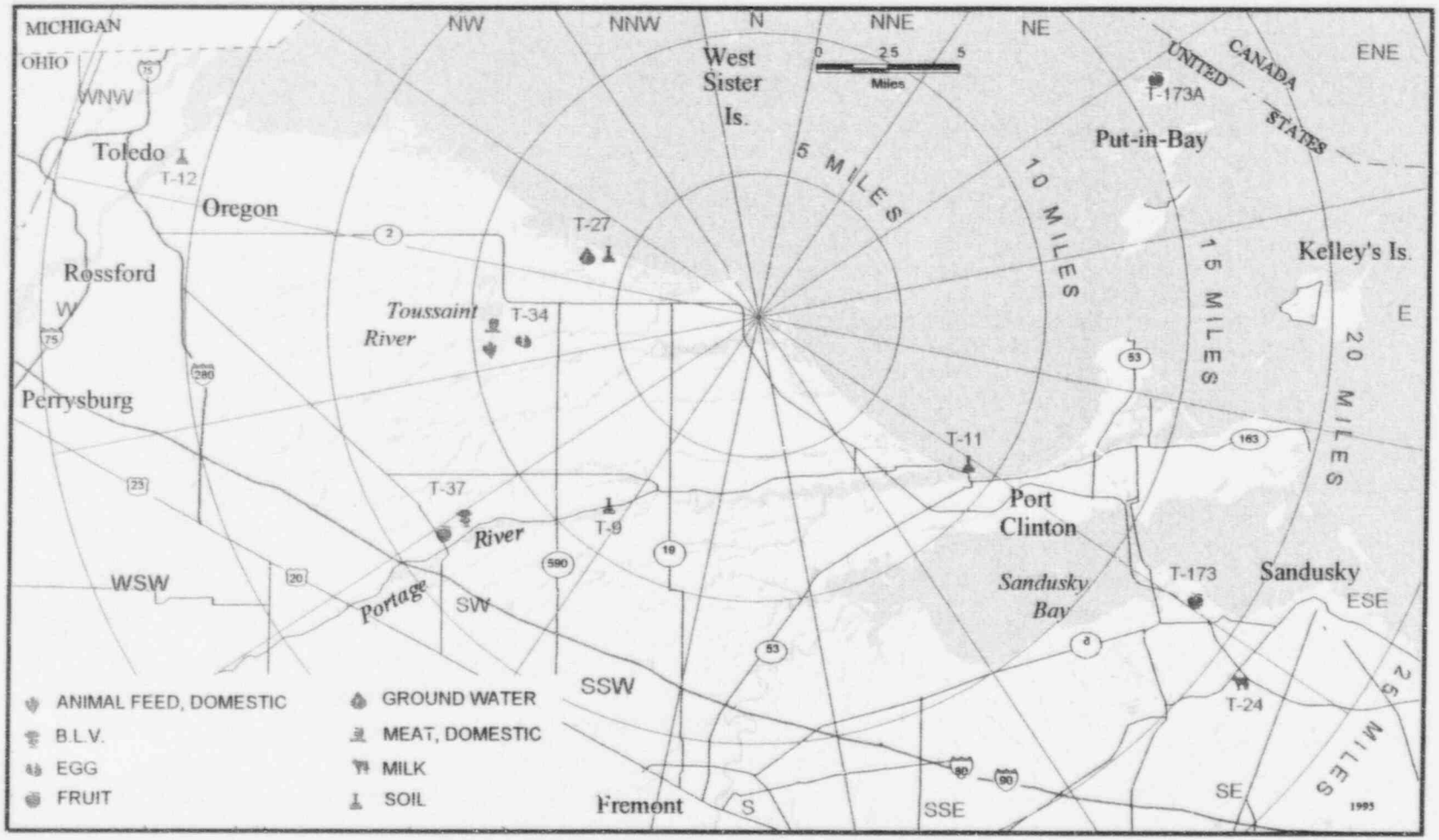
DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
TERRESTRIAL SAMPLES: 5 MILES RADIUS



ENVIRONMENTAL MONITORING

Figure 17

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
TERRESTRIAL SAMPLES: 5-25 MILE RADIUS



ENVIRONMENTAL MONITORING

Figure 18

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-28 and T-50) and two control locations (T-11 and T-12). These locations include the water treatment facilities for Davis-Besse, 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 for beta emitting radionuclides for indicator and control locations were 2.0 and 2.1 pCi/l respectively. These results are similar to previous years as shown in Figure 19. All quarterly tritium analysis results were less than the LLD of 330 pCi/l.

All cesium-137 results were less than the LLD of 10.0 pCi/l. Strontium-89 was not detected in any sample above 1.4 pCi/l. Strontium 90 was detected at 0.8 pCi/l at indicator locations and 0.7 pCi/l at control locations. These results are similar to those of previous years and indicate no adverse impact on the environment resulting from the operation of Davis-Besse.

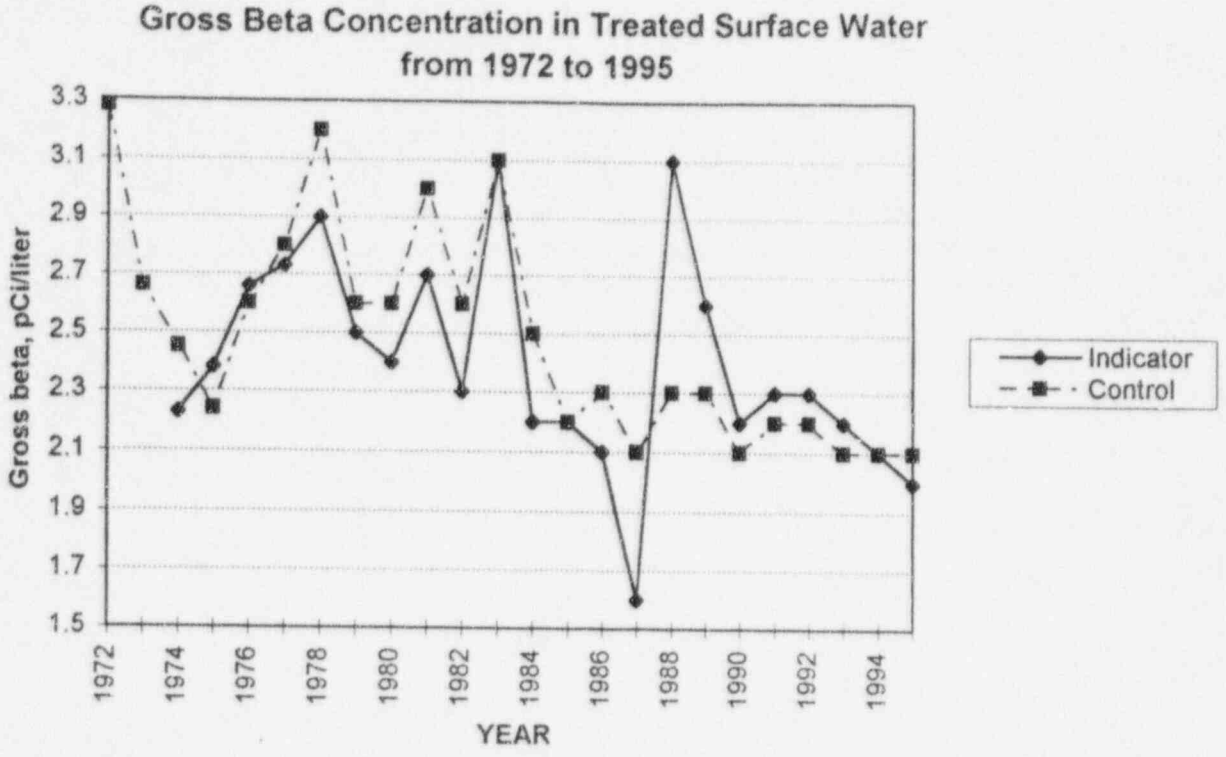


Figure 19: Since 1974, the annual concentrations of beta emitting radionuclides in treated surface water samples collected from indicator locations have been consistent with those from control locations. This shows that Davis-Besse has had no measurable radiological impact on surface water used to make 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-28	I	Treated Water supply from Davis-Besse site
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, Davis-Besse, 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 2.3 pCi/l at control locations respectively. The average concentration of beta emitting radionuclides in all samples (include lake water) was 2.6 pCi/l at both indication and control locations.

Of the 132 tritium analyses performed on untreated water, 123 were less than the LLD of 330 pCi/l. The tritium detected, ranged from a concentration of 330 pCi/l to 1234 pCi/l. The average concentration of tritium detected above the LLD was 681 pCi/l at indication location and 487 pCi/l at controls. It is presumed that the tritium detected at the indicator location may have been attributed to normal plant operation. The maximum tritium concentration detected is only 0.12% of the effluent concentration limit of 1,000,000 pCi/l for tritium in an unrestricted area, as provided by 10CFR20, Appendix B, Table 2, column 2. The tritium detected at the control location is presumed to come from activities not associated with the operation of Davis-Besse.

Cesium-137 and strontium-89 were not detectable in samples of untreated water above their LLDs of 10 pCi/l and 1.3 pCi/l, respectively. Strontium-90 was detected at an average concentration of 0.63 pCi/l at indicator locations and 0.65 pCi/l at control locations. The results of untreated water show that the operation of Davis-Besse had no adverse impact on nearby residents or on the environment.

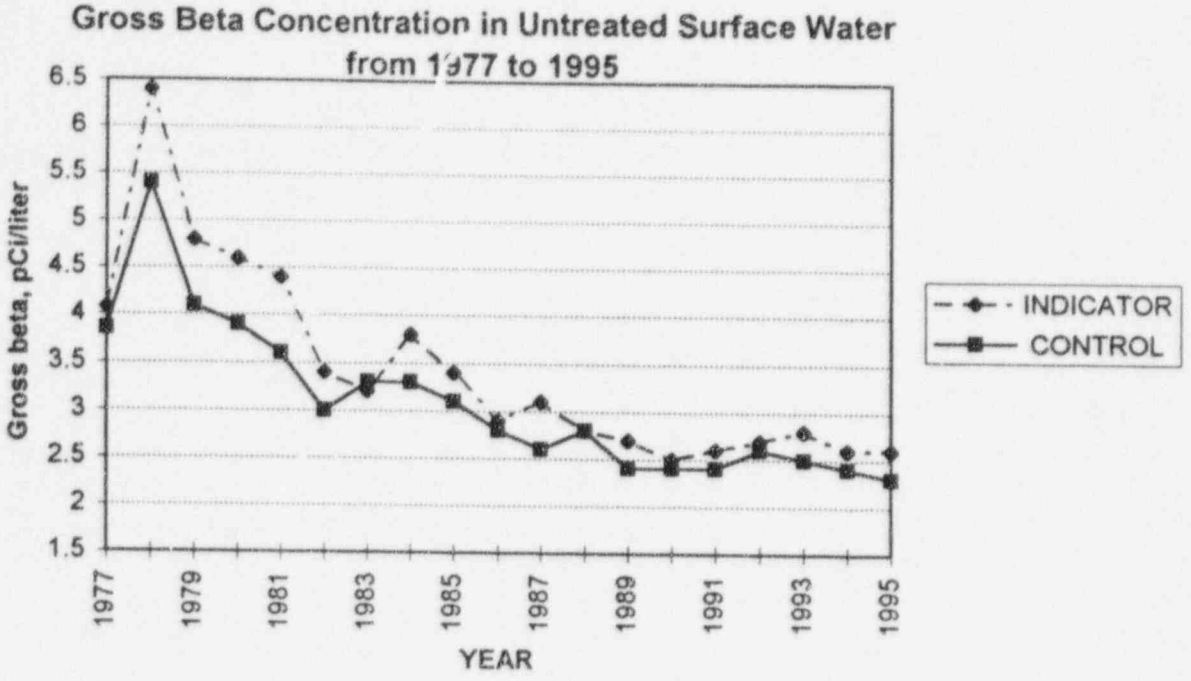


Figure 20: The average concentration of beta emitting radionuclides in untreated water was similar between control and indicator locations. This demonstrates, that Davis-Besse had no radiological impact on the surrounding environment.

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 concentrations of beta emitting radionuclides detected at the QC location was 2.5 pCi/l and 2.4 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-28	I	Davis-Besse Water Treatment Plant
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 and Bottom Sediment

The sampling of shoreline and bottom 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, or a hand held dredge. All samples were analyzed for gamma emitting radionuclides. Naturally occurring potassium-40 was detected at both controls and indicator locations. Cesium-137 was not detected at any location above the LLD of 0.048 pCi/g.

Atmospheric testing of nuclear weapons has been the principal source of cesium-137 in the environment to date. Although no atmospheric nuclear weapons tests have been reported since 1980, cesium-137 is still present in shoreline sediment samples because of its long half life (approximately 30 years). No other gamma emitting radionuclides were detected in any of the samples above their LLD. The concentrations of those detected were consistent with normal concentrations for this area and were not attributed to plant operation.

Table 14: Shoreline and Bottom 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) twice 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, white perch or white bass because they are an important commercial fish. Carp are collected because they are bottom feeders and thus would be more likely to be affected by radionuclides deposited in lake sediments. The edible portion of fish were analyzed for beta and gamma emitting radionuclides.

The average concentration of beta emitting radionuclides in fish muscle was similar for indicator and control locations (3.06 pCi/g and 3.34 pCi/g wet weight, respectively). Cesium-137 was not detected above the LLD <0.024 for indicator and control locations. No other gamma emitter were detected above their respective LLDs.

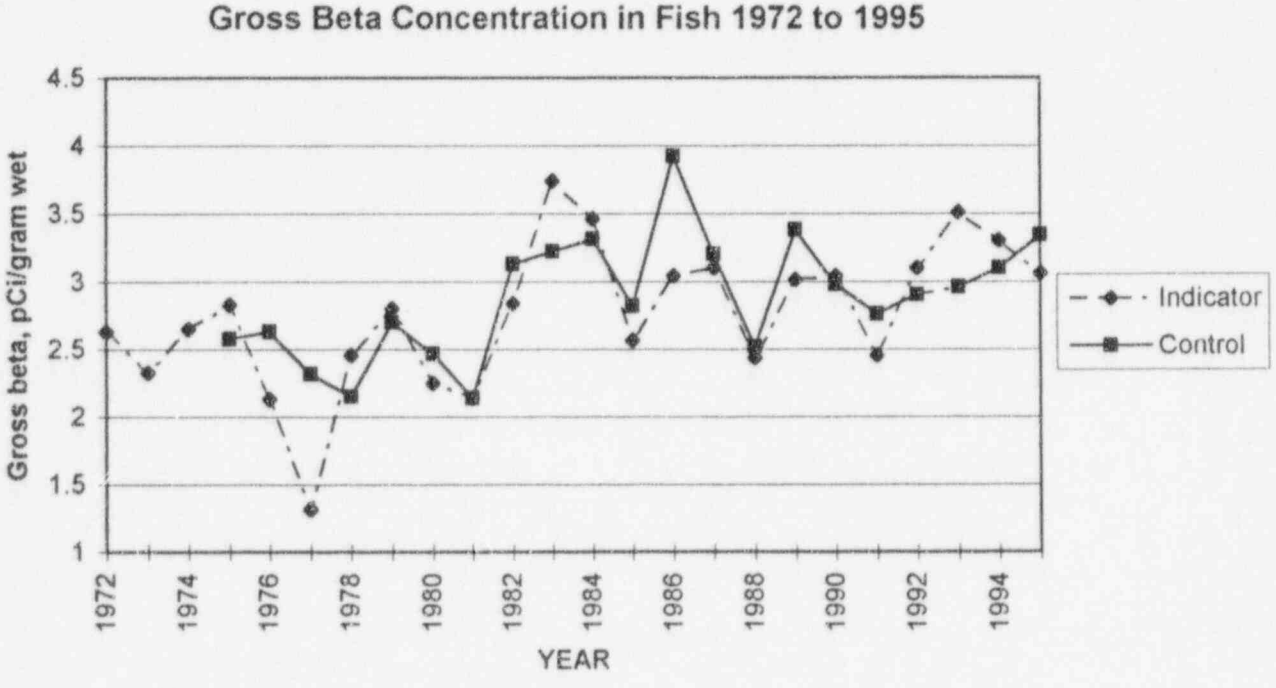


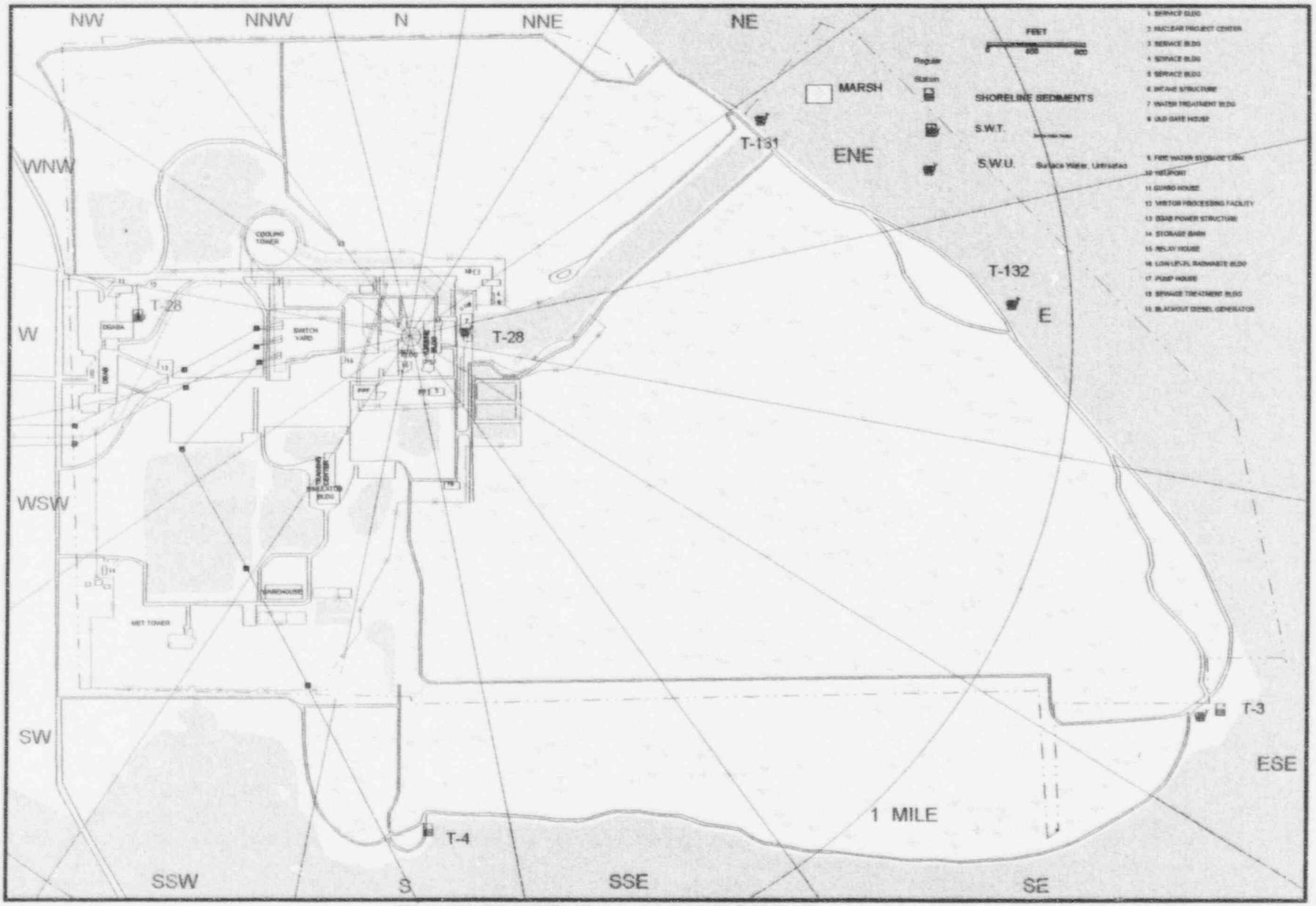
Figure 21: Average concentrations of beta emitting radionuclides in fish samples were similar at indicator and control locations and were within the range of results of previous years.

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

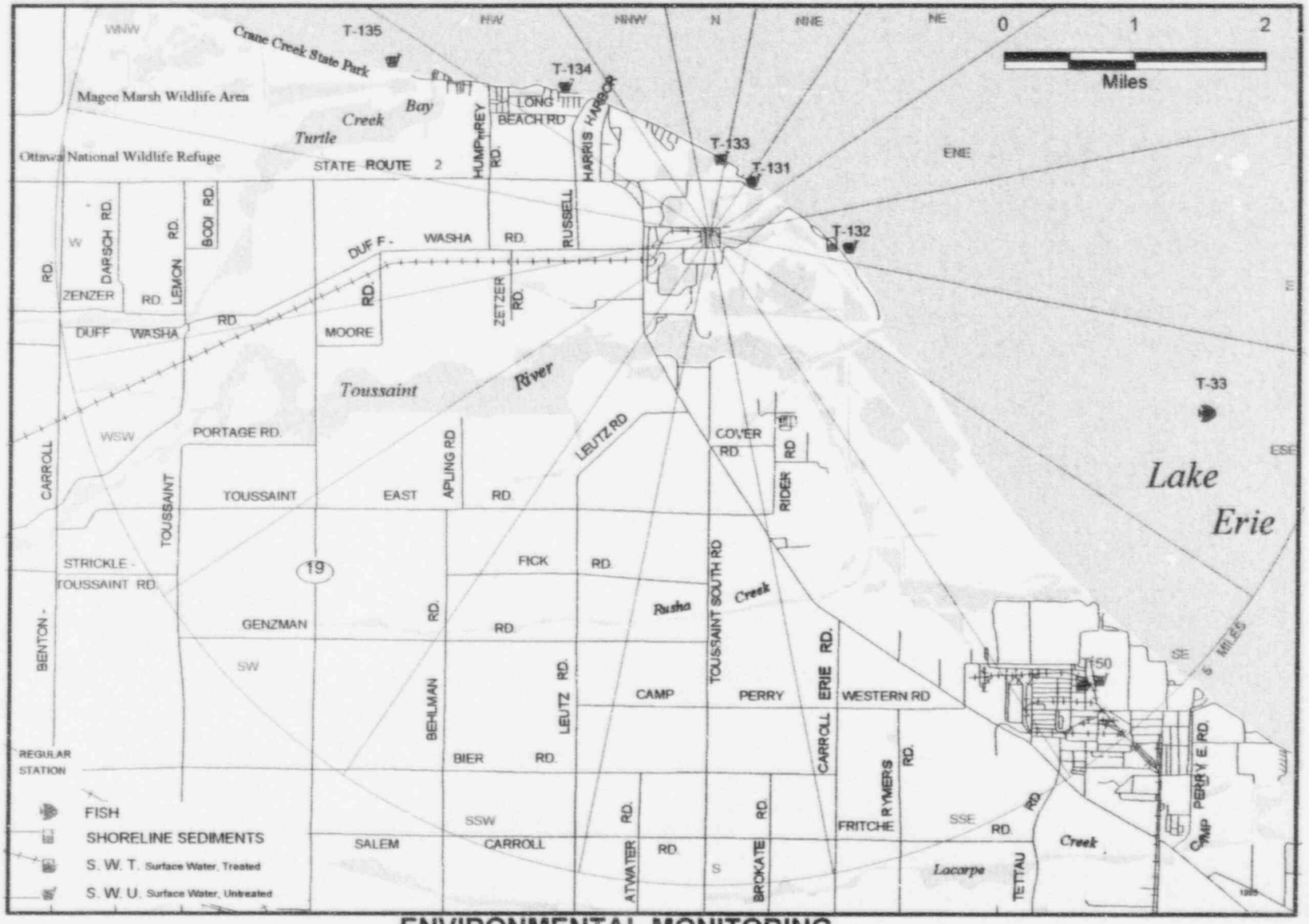
DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
AQUATIC SAMPLES: SITE



ENVIRONMENTAL MONITORING

Figure 22

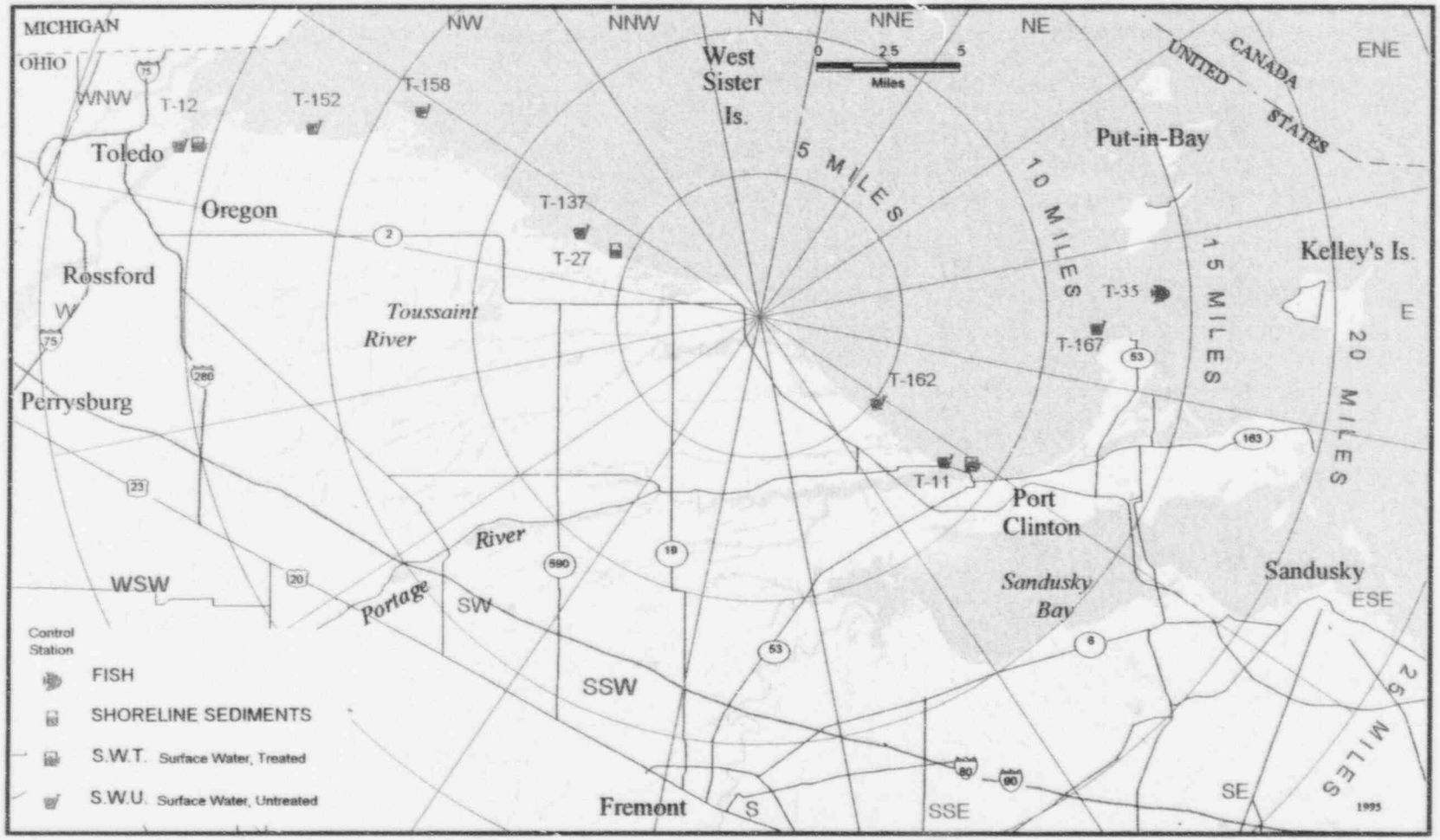
DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
AQUATIC SAMPLES: 5 MILE RADIUS



ENVIRONMENTAL MONITORING

Figure 23

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
AQUATIC SAMPLES: 5-25 MILE RADIUS



ENVIRONMENTAL MONITORING

Figure 24

Direct Radiation Monitoring

Thermoluminescent Dosimeters

Radionuclides present in the air, and those 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 rezeros 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 is 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 98.9% of the quarterly TLDs placed in the field and 95.7% of the annual TLDs placed in the field were retrieved and evaluated during the current reporting period.

In 1995, the average dose equivalent for quarterly TLDs at all indicator locations was 13.0 mrem/91 days, and for all control locations was 14.2 mrem/91 days. The average dose equivalent for annual TLDs in 1995 was 54.5 mrem/365 days at indicator locations and 58.2 mrem/365 days for control locations. These results are similar to those observed in past years; in 1974, 55-62 mrem in one year was reported as being the annual average dose equivalent.

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 13.5 mrem/91 days while the quality control TLDs yielded an average dose equivalent of 13.0 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.

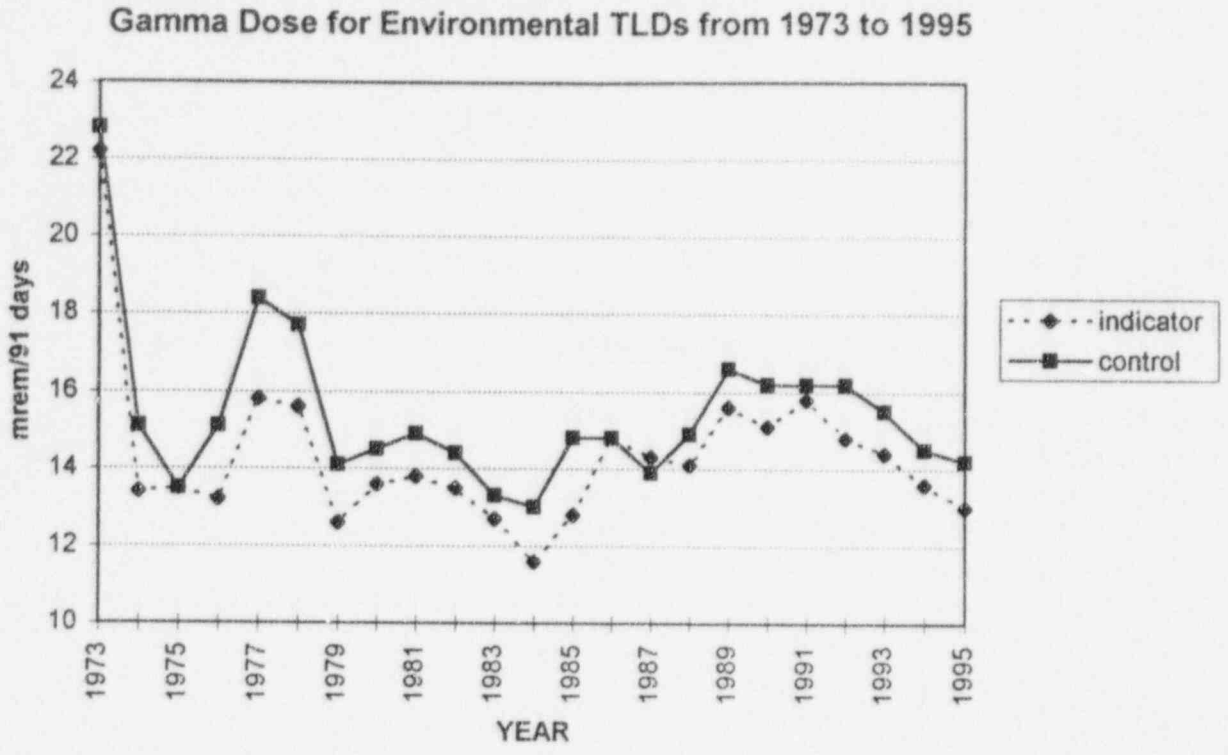


Figure 25: The similarity between indicator and control results demonstrated that the operation of Davis-Besse has not caused any abnormal gamma dose.

NRC TLD Monitoring

The NRC has 22 TLDs located around Davis-Besse as part of their Direct Monitoring Network Program. Davis-Besse maintains TLDs at all the NRC TLD monitoring sites. The NRC collects their TLDs on a quarterly basis, whereas Davis-Besse collects TLDs quarterly and annually at these locations. The NRC TLDs are collected and read independently of Davis-Besse's TLDs, thus providing a quality control check on both laboratories.

The NRC uses Panasonic Model UD801 TLD, which has two elements of lithium borate: copper ($Li_2B_4O_7$: Cu) and two elements of calcium sulfate: thulium ($CaSO_4$: Tm). The difference in TLD material used by the NRC and Davis-Besse will cause some minor variation in results.

The results of TLD monitoring at these 22 locations show good consistency between the NRC TLDs and the Davis-Besse TLDs. The average dose equivalent of the quarterly results are 13.7±2.3 mrem/91 days for the Davis-Besse TLDs and 17.1±2.6 mrem/91 days for the NRC TLDs. As the confidence intervals overlap, there is no statistical difference between the measurements.

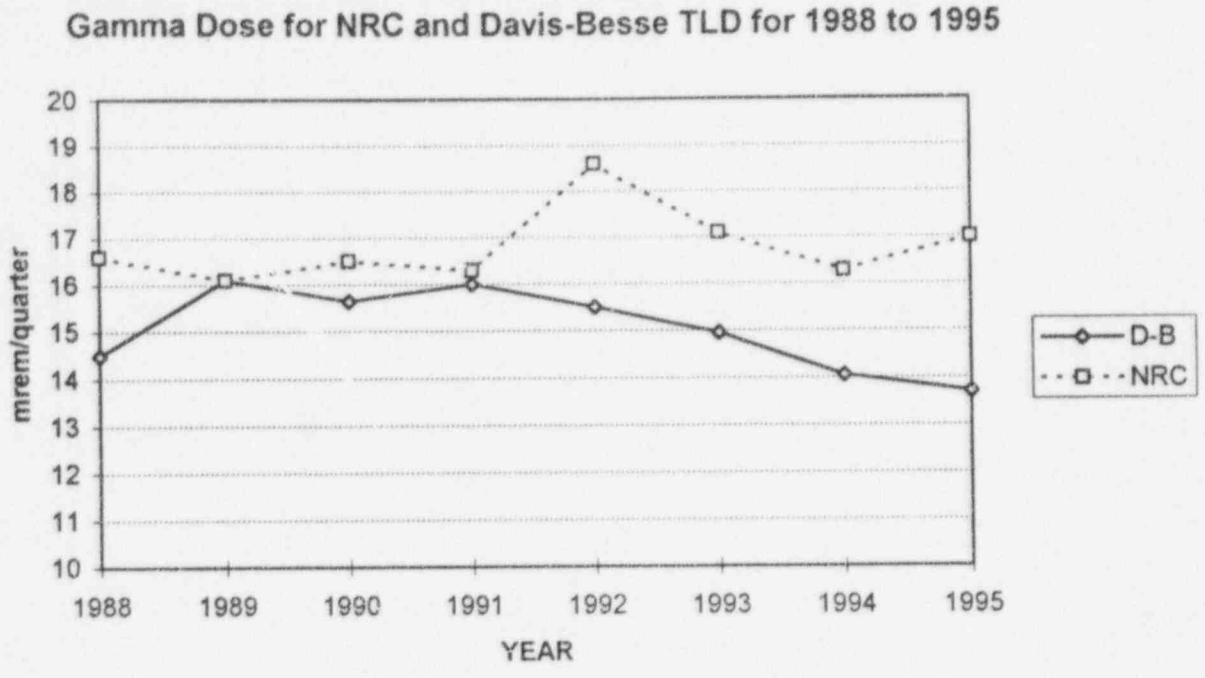


Figure 26: Comparison of NRC and Davis-Besse TLDs

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

Table 16: Thermoluminescent Dosimeter Locations (continued)

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-23	C	South Bass Island, 14.3 miles ENE of Station, near lighthouse
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
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	Daup Farm, 5.5 miles SSE of Station

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
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-61	I	Site boundary, 0.6 miles SE 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
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

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
T-85	QC	Quality Control Site
T-86	QC	Quality Control Site
T-88	QC	Quality Control Site
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
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

Table 16: Thermoluminescent Dosimeter Locations (continued)

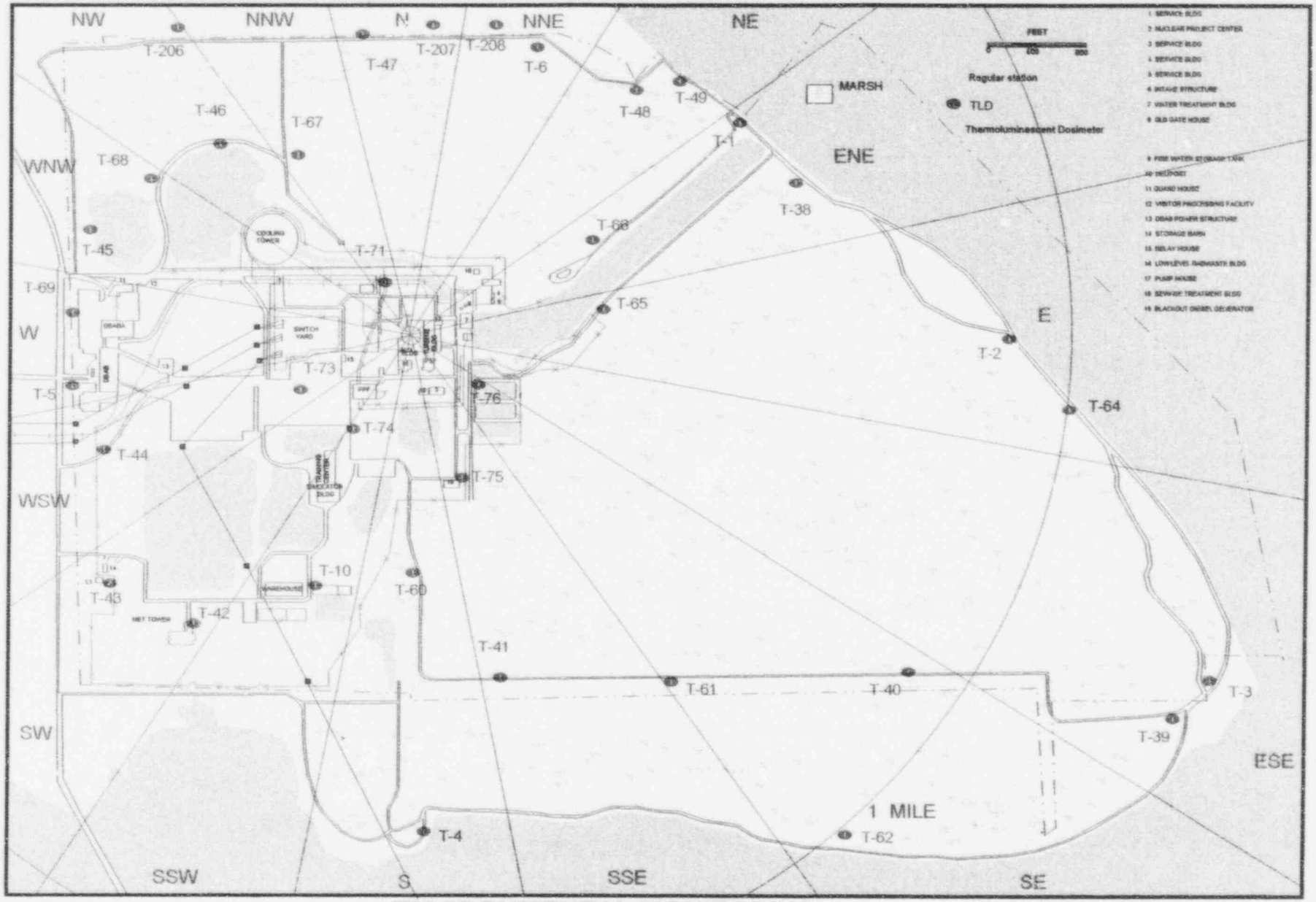
Sample Location Number	Type of Location	Location Description
T-120	QC	Quality Control Site
T-121	I	State Route 19, 2.0 miles W of Station
T-122	I	Duff Washa and Humphrey Road, 1.7 miles W of Station
T-123	I	Zetzer Road, 1.6 miles WSW of Station
T-124	C	Church and Walnut Street, Oak Harbor, 6.5 miles 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
T-128	I	Erie Industrial Park, Port Clinton Road, 4.0 miles SE 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

Table 16: Thermoluminescent Dosimeter Locations (continued)

Sample Location Number	Type of Location	Location Description
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

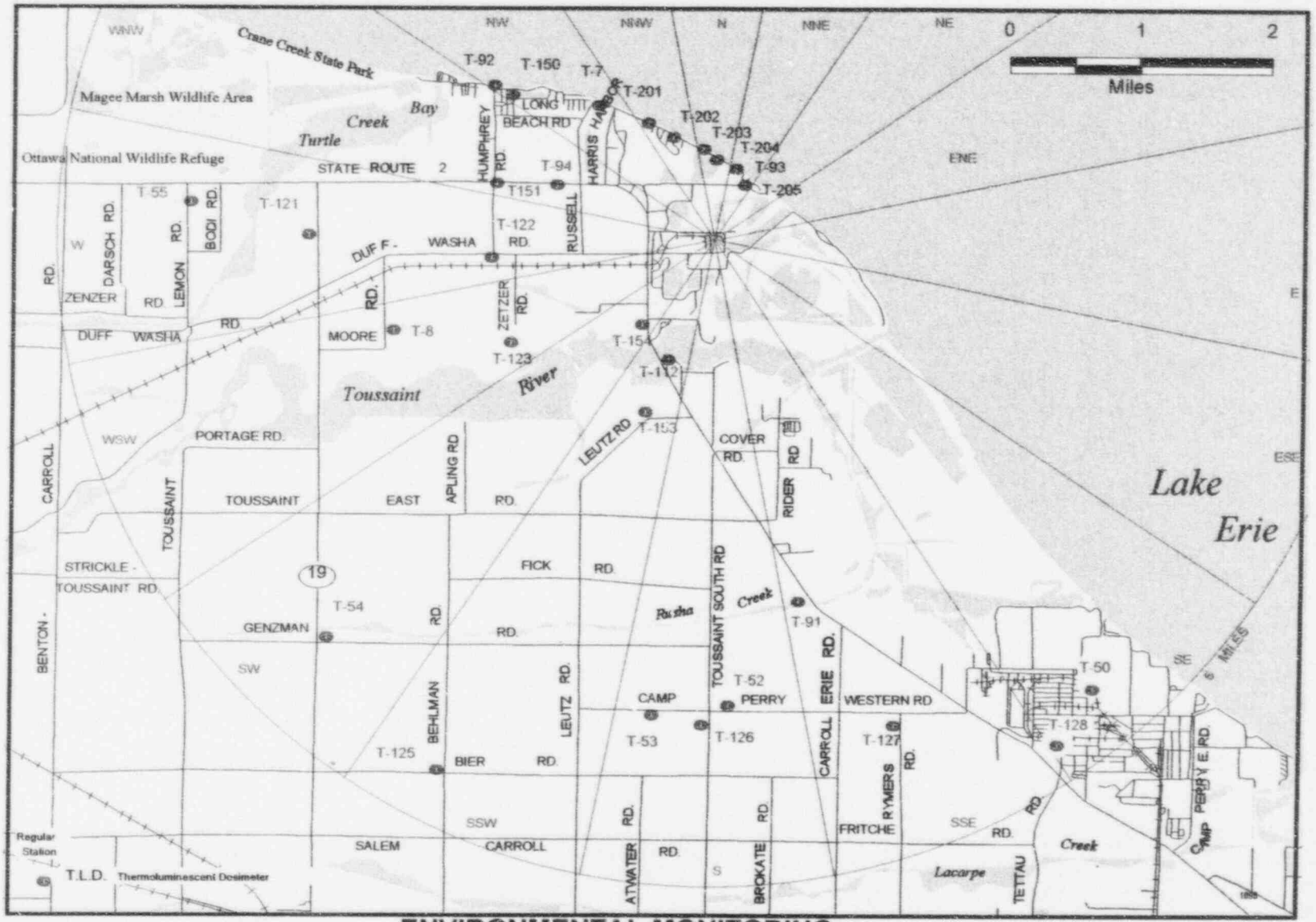
DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
TLD SAMPLES: SITE



ENVIRONMENTAL MONITORING

Figure 27

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
TLD SAMPLES: 5 MILE RADIUS

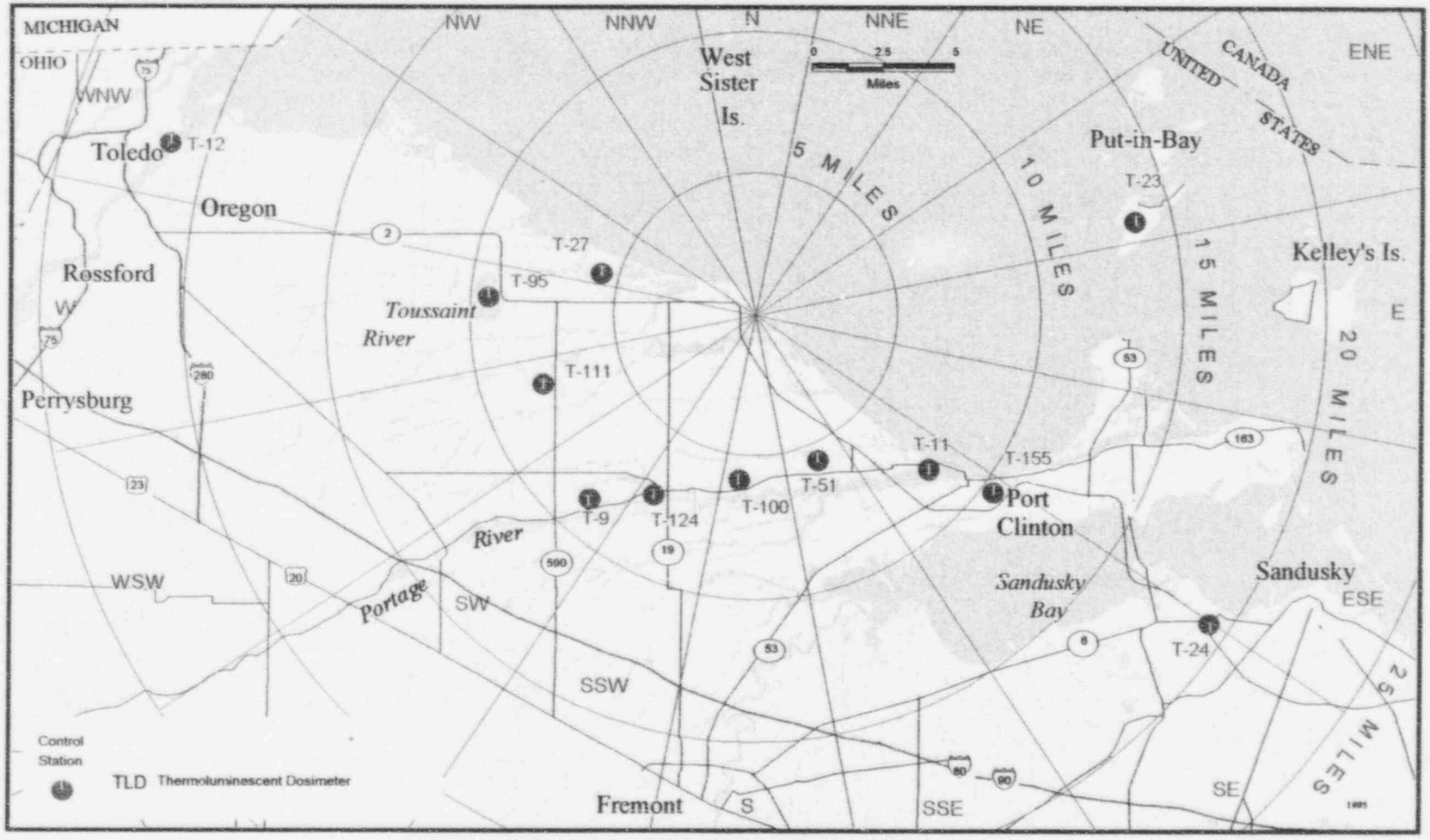


ENVIRONMENTAL MONITORING

Figure 28

DAVIS-BESSE NUCLEAR POWER STATION
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TLD SAMPLES: 5-25 MILE RADIUS



ENVIRONMENTAL MONITORING

Figure 29

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 1995. Davis-Besse's operation in 1995 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 1995 are summarized in Appendix D of this report.

References

1. "Cesium-137 from the Environment to Man: Metabolism and Dose," Report No.52, National Council on Radiation Protection and Measurement, Washington, D.C. (January 1977).

2. "Environmental Radiation Measurements," Report No.50, National Council on Radiation Protection and Measurement, Washington, D.C. (December 1976).

3. "Exposure of the Population in the United States and Canada from Natural Background Radiation," Report No.94, National Council on Radiation Protection and Measurement, Washington, D.C. (December 1987).

4. "A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations," DOE/EP-0023, Department of Energy, Washington, D.C. (July 1981).

5. "Ionizing Radiation Exposure of the Population of the United States," Report No.93, National Council on Radiation Protection and Measurement, Washington, D.C. (September 1987).

6. "Natural Background Radiation in the United States," Report No.45, National Council on Radiation Protection and Measurement, Washington, D.C. (November 1975).

7. "Numerical Guides for Design Objectives and Limiting Conditions for Operation to meet the Criterion 'As Low As Reasonably Achievable' for Radioactive Material in Light Water Cooled Nuclear Power Reactor Effluents," Code of Federal Regulations, Title 10 Energy, Part 50 "Domestic Licensing of Production and Utilization Facilities," Appendix I (1988).

8. "Performance, Testing and Procedural Specifications for Thermoluminescent Dosimetry," American National Standards Institute, Inc., ANSI-N45-1975, New York, New York (1975).

9. "Public Radiation Exposure from Nuclear Power Generation in the United States," Report No.92, National Council on Radiation Protection and Measurement, Washington, D.C. (December 1987).

10. "Radiological Assessment: Predicting the Transport ,Bioaccumulation and Uptake by Man of Radionuclides Released to the Environment," Report No.76, National Council on Radiation Protection and Measurement, Washington, D.C. (March 1984).

11. Regulatory Guide 4.1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," US NRC (April 1975).

12. Regulatory Guide 4.13, "Performance, Testing, and Procedural Specifications for Thermoluminescent Dosimetry: Environmental Applications," US NRC (July 1977).

13. Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment," US NRC (February 1979).

14. Regulatory Guide 0475, "Radiological Environmental Monitoring by NRC Licensees for Routine Operations of Nuclear Facilities," US NRC (September 1978).

15. Regulatory Guide 0837, "NRC TLD Direct Radiation Monitoring Network," US NRC (1995).

16. "Standards for Protection Against Radiation," Code of Federal Regulations, Title 10, Energy, Part 20 (1993).

17. Teledyne Isotopes Midwest Laboratory, "Operational Radiological Monitoring for the Davis-Besse Nuclear Power Station Unit No.1, Oak Harbor, OH," Annual Report, Parts I and II (1977 through 1990).

18. Teledyne Isotopes Midwest Laboratory, "Final Monthly Progress Report to Toledo Edison Company", (1991-1995).

19. Teledyne Isotopes Midwest Laboratory, "Preoperational Environmental Radiological Monitoring for the Davis-Besse Power Station Unit No. 1", Oak Harbor, Oh (1972-1977).

20. Toledo Edison Company, "Davis-Besse: Nuclear Energy for Northern Ohio."

21. Toledo Edison Company, "Davis-Besse Nuclear Power Station, Unit No. 1, Radiological Effluent Technical Specifications," Volume 1, Appendix A to License No. NPF-3.

22. Toledo Edison Company, "Final Environmental Statement -Related to the Construction of Davis-Besse Nuclear Power Station," Docket #50-346 (1987).

23. Toledo Edison Company, "Performance Specifications for Radiological Environmental Monitoring Program," S-72N.

24. Toledo Edison Company, "Radiological Environmental Monitoring Program," DP-HP-00015.

25. Toledo Edison Company, "Radiological Environmental Monitoring Quarterly, Semiannual, and Annual Sampling", DB-HP-03004.

26. Toledo Edison Company, "Radiological Monitoring Weekly, Semimonthly, and Monthly Sampling," DB-HP-03005.

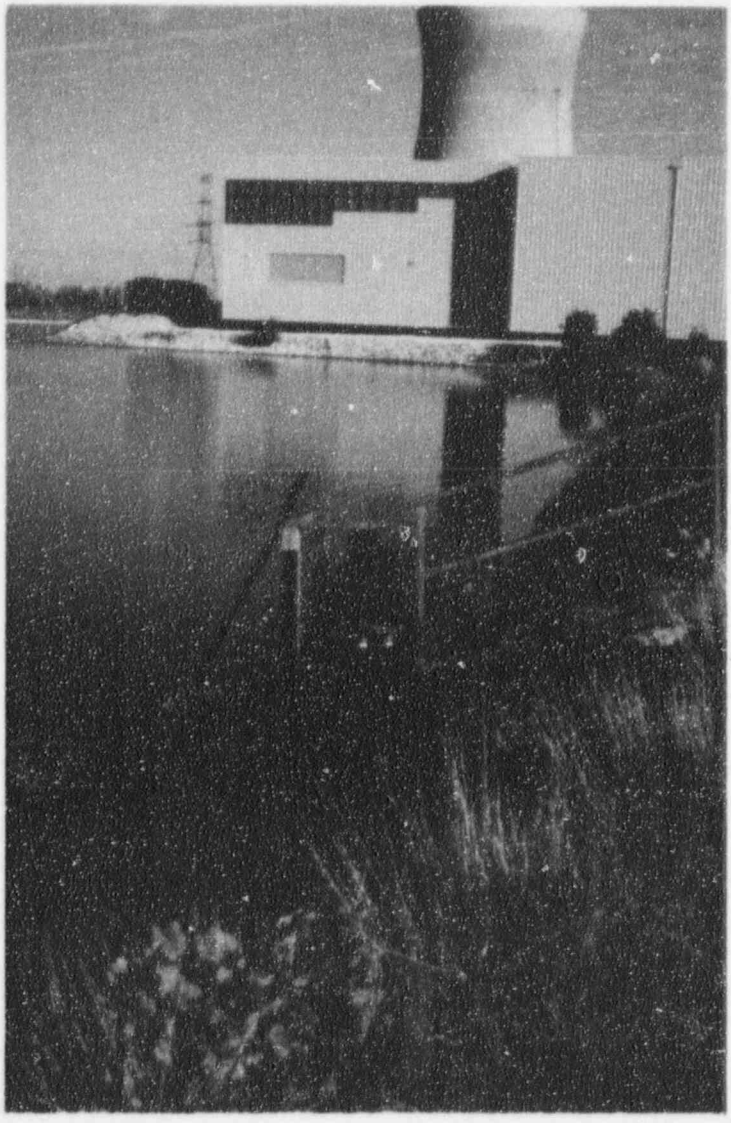
27. Toledo Edison Company, "REMP Enhancement Sampling," DB-HP-10101.

28. Toledo Edison Company, "Updated Safety Analysis for the Offsite Radiological Monitoring Program," USAR 11.6, Revision 14, (1992).

29. Toledo Edison Company, "Annual Radiological Environmental Operating Report Preparation and Submittal," DB-HP-00014.

30. Toledo Edison Company, Davis-Besse Nuclear Power Station, Offsite Dose Calculation Manual

31. "Tritium in the Environment," Report No. 62, National Council on Radiation Protection and Measurements, Washington, D.C. (March 1979).



Radioactive Effluent Release Report

Radioactive Effluent Release Report January 1 through December 31, 1995

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 and Centerior Energy minimize health risk and environmental detriment and ensure 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 cesiums and cobalts 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. Information on the water flow, wind speed, and wind direction at the time of a gaseous or liquid release is used to evaluate how the radionuclides will be distributed in an area. 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.

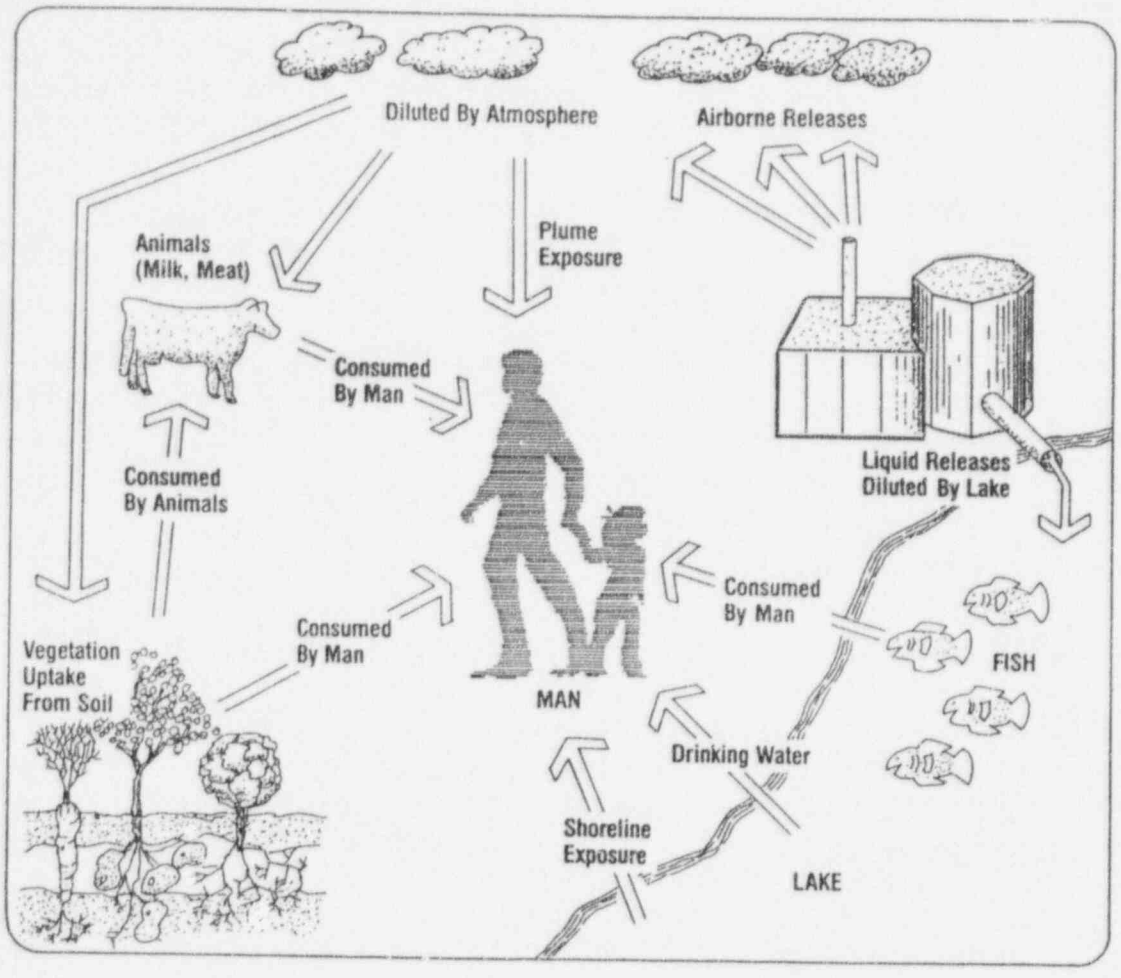


Figure 30: The exposure pathways shown here, are monitored through the Radiological Environmental Monitoring Program (REMP), and are considered when calculating doses to the public.

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 Station during the period from January 1, 1995 through December 31, 1995.

- 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:

- 1.03E-01 mrem, whole body
- 1.35E-01 mrem, liver

Gaseous Effluents:

Noble Gas:

- 3.52E-03 mrad, whole body
- 1.34E-02 mrad, skin

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

- 3.94E-03 mrem, whole body
- 1.70E-02 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.

There were no abnormal liquid releases and no abnormal gaseous releases during this reporting period.

No changes to the Process Control Program (PCP) occurred during this time period. Revisions 8 and 9 to the Offsite Dose Calculation Manual were written and approved during this reporting period and accompanies 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 5 mrad total for gamma radiation and less than or equal to 10 mrad total for beta radiation in any calendar quarter.
- 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 7.5 mrem total to any organ in any calendar quarter.
- 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 1.5 mrem to the total body and less than or equal to 5 mrem to any organ in any calendar quarter.
- 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 1x10-5 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 (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.

Iodines

Iodines are 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 1/1/95 through 12/31/95

1. Number of batch releases: 54
2. Total time period for the batch releases: 92.2 hours
3. Maximum time period for a batch release: 207 minutes
4. Minimum time period for a batch release: 73 minutes
5. Average time period for a batch release: 102 minutes

Gaseous from 1/1/95 through 12/31/95

1. Number of batch releases: 12
2. Total time period for the batch releases: 153.8 hours
3. Maximum time period for a batch release: 1427 minutes
4. Minimum time period for a batch release: 49 minutes
5. Average time period for batch release: 769 minutes

Abnormal Releases

No abnormal releases occurred during this reporting period.

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, 1995 through December 31, 1995.

	SPECIFICATION	ANNUAL DOSE	LIMIT	PERCENT OF LIMIT
Report Period: January 1, 1995 - December 31, 1995 (gaseous)				
	Noble gases (gamma)	3.52E-03 mrad	10 mrad	3.52E-02
	Noble gases (beta)	1.34E-03 mrad	20 mrad	6.70E-02
	I-131, tritium and particulates	1.70E-02 mrad	15 mrem	1.13E-01
Report Period: January 1, 1995 - December 31, 1995 (liquid)				
	Total body	1.03E-01 mrem	3 mrem	3.43E+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 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 located inside DBNPS controlled area is also accessible to members of the public. 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 maximumally-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 are no areas 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.

- RE 4598BA was inoperable from 11/1/95 to 12/28/95 due to flow measuring system failure. No replacement parts were available because the system is obsolete and no longer manufactured. A new flow system was ordered and installed. During this time a redundant system, RE 4598AA, was operable.

- FT 5090 was inoperable from 3/21/95 to 5/26/95 due to erratic reading caused by a flow element failure. The problem was investigated, repaired, the instrument returned to service. During this time a redundant system, FT5090A, was operable.

- FT 1821A was inoperable from 10/30/95 to 2/28/96 when the lithium battery for the flow relay indicator failed. A replacement part was not available. After the part was received, the equipment was repaired and returned to service. While FT1821A was inoperable, a redundant flow transmitter was operable.

- FQI 1700B was inoperable from 7/17/95 to 8/21/95 when a flow integrating indicator failed. The equipment was repaired and returned to service. During the time this was inoperable, no releases were made from this pathway. Also, a redundant system was available.

- Total Dilution Flow, computer point F201, was unavailable from 6/12/95 to 7/28/95 when one of the input points, F890 Service Water Outflow, failed. Upon completion of maintenance activities, the computer point was returned to service. During the time F201 was inoperable, total dilution was estimated using other methods.

Changes to the ODCM and PCP

There were no changes to the PCP and two revisions (8 and 9) to the ODCM.

Borated Water Storage Tank Radionuclide Concentration

During this reporting period, the total activity did not exceed the activity limits listed in Davis-Besse ODCM.

Table 17
Gaseous Effluents - Summation of All Releases

Type	Unit	1st Qtr 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995	Est. Total % Error
Fission and Activation Gases						
Total Release	Ci	3.73E+01	1.44E+02	9.28E+1	2.72E+01	2.50E+01
Average Release Rate for Period[a]	µCi/sec	4.73E+00	1.83E+01	1.18E+01	3.45E+00	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limits Section					
Iodines						
Total Iodines	Ci	7.38E-05	1.97E-04	2.36E-04	6.57E-05	2.50E+01
Average Releases Rate for Period[a]	µCi/sec	9.36E-06	2.50E-05	2.99E-05	8.33E-06	
Percent of ODCM limits	See Supplemental Information in ODCM Release Limits Section					
Particulates						
Particulates with half-lives greater than 8 days	Ci	8.17E-07	3.91E-07	1.26E-06	LLD	2.50E+01
Average Release Rate for Period[a]	µCi/sec	1.04E-07	4.96E-08	1.60E-07	N/A	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limit Section					
Gross Alpha Activity	Ci	3.65E-07	LLD	1.94E-07	2.99E-08	2.50E+01
Tritium						
Total Release	Ci	7.14E+00	5.42E+00	3.99E+00	4.50E+00	2.50E+01
Average Release Rate for Period[a]	µCi/sec	9.06E-01	6.87E-01	5.06E-01	5.71E-01	
Percent of ODCM Limits	See Supplemental Information in ODCM Release Limit 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]

Nuclides	Unit	1st Qtr 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995
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
Xe135		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	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		2.98E-03	6.25E-03	3.52E-03	5.90E-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
Total for Period:		2.98E-03	6.25E-03	3.52E-03	5.90E-03

Table 18 (Continued)
Gaseous Effluents - Ground Level Releases
Continuous Mode[c]

Nuclides	**Unit**	**1st Qtr 1995**	**2nd Qtr 1995**	**3rd Qtr 1995**	**4th Qtr 1995**
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
Xe135		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		3.63E-02	6.18E-02	7.07E-02	8.03E-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:		3.63E-02	6.18E-02	7.07E-02	8.03E-02

Table 18 (Continued)
Gaseous Effluents - Ground Level Release
Continuous and Batch Modes

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-07	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-06	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, AVV Testing, 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) listed below:

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

Table 19
Gaseous Effluents - Mixed Mode Releases
Batch Mode

Nuclides	Unit	1st Qtr 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995
Fission Gases					
Ar-41	Ci	1.72E-02	4.78E-02	1.40E-02	2.23E-02
Kr-85	Ci	1.74E-01	1.14E+00	4.63E-01	1.12E+00
Kr-85m	Ci	1.04E-03	3.28E-03	1.09E-03	1.35E-03
Kr-87	Ci	LLD[b]	LLD[b]	LLD[b]	LLD[b]
Kr-88	Ci	LLD	LLD	LLD	LLD
Xe-131m	Ci	2.91E-01	9.96E-01	3.16E-01	2.92E-01
Xe-133	Ci	1.75E+01	8.02E+01	1.69E+01	1.28E+01
Xe-133m	Ci	8.34E-02	3.95E-01	7.15E-02	6.59E-02
Xe-135	Ci	2.76E-02	9.85E-02	3.05E-02	3.28E-02
Xe-135m	Ci	LLD	LLD	LLD	LLD
Xe-138	Ci	LLD	LLD	LLD	LLD
Total for Period:		1.81E+01	8.29E+01	1.78E+01	1.43E+01
***Iodines**					
***Particulates**					
H-3	Ci	3.11E-02	1.10E-01	3.51E-02	4.94E-02
Total for Period:	Ci	3.11E-02	1.10E-01	3.51E-02	4.94E-02

*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 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995
Fission Gases					
Ar-41	Ci	LLD[a]	LLD[a]	LLD[a]	LLD[a]
Kr-85	Ci	LLD	LLD	LLD	LLD
Kr-85m	Ci	LLD	4.04E-01	LLD	LLD
Kr-87	Ci	LLD	LLD	LLD	LLD
Kr-88	Ci	LLD	LLD	LLD	LLD
Xe-131m	Ci	LLD	LLD	LLD	LLD
Xe-133	Ci	1.90E+01	5.73E+01	7.24E+01	1.23E+01
Xe-133m	Ci	LLD	LLD	LLD	LLD
Xe-135	Ci	LLD	3.48E+00	2.58E+00	5.92E-01
Xe-135m	Ci	LLD	LLD	LLD	LLD
Xe-138	Ci	LLD	LLD	LLD	LLD
Total for Period:		1.90E+01	6.12E+01	7.50E+01	1.29E+01
Iodines					
I-131	Ci	5.63E-05	1.61E-04	1.26E-04	4.56E-05
I-133	Ci	1.75E-05	3.57E-05	1.10E-04	2.00E-05
I-135	Ci	LLD	LLD	LLD	LLD
Total for Period		7.38E-05	1.96E-04	2.36E-04	6.57E-05
Particulates and Tritium					
H-3	Ci	7.07E+00	5.24E+00	3.88E+00	4.37E+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	8.17E-07	3.91E-07	1.26E-06	LLD
Ba-140	Ci	LLD	LLD	LLD	LLD
La-140	Ci	LLD	LLD	LLD	LLD
Total for Period:		7.07E+00	5.24E+00	3.88E+00	4.37E+00

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

	Continuous Mode[a]		Batch Mode[a]
Ar-41	<2.9E-08 µCi/ml	Kr-87	<4.5E-06 µCi/ml
Kr-85	<3.3E-06 µCi/ml	Kr-88	<6.6E-06 µCi/ml
Kr-85m	<1.3E-08 µCi/ml	Xe-135m	<1.4E-05 µCi/ml
Kr-87	<6.0E-08 µCi/ml	Xe-135	<2.1E-06 µCi/ml
Kr-88	<6.0E-08 µCi/ml	Xe-138	<2.8E-05 µCi/ml
Xe-131m	<4.4E-07 µCi/ml		
Xe-133m	<7.2E-08 µCi/ml		
Xe-135	<1.1E-08 µCi/ml		
Xe-135m	<5.9E-06 µCi/ml		
Xe-138	<2.0E-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]	<1.6E-14 µCi/ml		
Co-60[c]	<2.5E-14 µCi/ml		
Zn-65[c]	<3.5E-14 µCi/ml		
Mo-99[c]	<1.0E-13 µCi/ml		
Cs-134[c]	<1.8E-14 µCi/ml		
Cs-137[c]	<1.6E-14 µCi/ml		
Ce-141[c]	<1.3E-14 µCi/ml		
Ce-144[c]	<1.2E-13 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 every quarter in concentrations above the lower limit of detection (LLD) listed below. 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 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995	Est. Total % Error
Fission and Activation Products						
Total Release(without Tritium. Gases, Alpha)	Ci	5.59E-02	5.67E-03	5.21E-03	1.79E-03	2.00E+01
Average Diluted Concentration during Period[a]	µCi/ml	6.34E-09	6.67E-10	5.21E-10	1.90E-10	
Percent of ODCM Limit	%	See Supplement information in ODCM Release Limits Section				
Percent of 10CFR20 Limit	%	9.05E-02	4.09E-02	2.57E-02		
Tritium						
Total Release	Ci	2.56E+01	3.11E+01	7.42E+01	3.66E+01	2.00E+01
Average Diluted Concentration During Period[a]	µCi/ml	2.90E-06	3.66E-06	7.42E-06	3.88E-06	
P- -ent of 10CFR20 Limit	%	2.90E-01	3.66E-01	7.42E-01	3.88E-01	
D- -d and Entrained Gases						
- Release	Ci	6.50E-05	3.57E-04	8.00E-03	1.50E-03	2.00E+01
Average Diluted Concentration During Period[a]	µCi/ml	7.38E-12	4.20E-11	8.00E-10	1.59E-10	
Percent of 10CFR20 Limit	%	3.69E-06	2.10E-05	4.00E-04	7.94E-05	
Gross Alpha						
Total Release	Ci	9.35E-06	LLD	LLD	1.09E-03	2.00E+01
Volume of Waste Released (prior to dilution)						
Batch	liter	3.31E+05	3.97E+05	5.27E+05	3.06E+05	2.00E+01
Continuous	liter	1.23E+08	1.05E+08	9.65E+07	1.74E+08	2.00E+01
Volume of Dilution Water						
Batch	liter	1.04E+08	1.49E+08	1.48E+08	8.10E+07	2.00E+01
Continuous	liter	8.58E+09	8.24E+09	9.75E+09	9.18E+09	2.00E+01
Total Volume of Water Released	liter	8.81E+09	8.50E+09	1.00E+10	9.44E+09	

a Tritium and alpha are found in both continuous and batch releases. Average diluted concentrations are based on total volume of water 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

Nuclides	Unit	1st Qtr 1995	2nd Qtr 1995	3rd Qtr 95	4th Qtr 95
Fission and Activation Products					
Na-24	Ci	LLD[a]	LLD[a]	LLD[a]	1.25E-06
Cr-51	Ci	4.32E-04	LLD	LLD	LLD[a]
Mn-54	Ci	1.09E-04	LLD	1.01E-06	LLD
Fe-55	Ci	7.28E-03	4.37E-04	6.85E-04	3.68E-04
Fe-59	Ci	LLD	LLD	LLD	LLD
Co-57	Ci	2.19E-04	1.34E-05	7.96E-06	9.91E-07
Co-58	Ci	2.86E-02	1.12E-03	4.21E-04	1.43E-04
Co-60	Ci	7.03E-03	4.40E-04	5.70E-04	1.94E-04
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	3.75E-04	LLD	LLD	2.36E-06
Zr-95	Ci	3.42E-04	8.65E-06	LLD	LLD
Zr-97	Ci	3.75E-04	3.43E-06	LLD	LLD
Mo-99	Ci	LLD	LLD	LLD	LLD
Tc-99m	Ci	LLD	LLD	LLD	LLD
Ru-103	Ci	4.00E-05	LLD	LLD	LLD
Ag-110m	Ci	7.29E-03	3.29E-04	5.77E-04	1.07E-04
Sn-113	Ci	1.72E-04	4.49E-06	LLD	LLD
Se-75	Ci	5.34E-06	LLD	LLD	LLD
Sb-125	Ci	8.46E-04	2.25E-04	6.84E-04	4.10E-04
I-131	Ci	1.42E-05	3.32E-05	2.47E-04	9.42E-05
I-133	Ci	LLD	1.73E-06	3.85E-05	4.46E-05
I-135	Ci	LLD	LLD	LLD	3.92E-06
Te-132	Ci	LLD	LLD	LLD	LLD
Cs-134	Ci	8.57E-04	1.02E-03	5.68E-04	1.23E-04
Cs-137	Ci	1.76E-03	2.04E-03	1.35E-03	2.95E-04
Ce-144	Ci	2.05E-04	LLD	LLD	LLD
La-140	Ci	LLD	LLD	LLD	LLD
Ba-140	Ci	LLD	LLD	LLD	LLD
Np-239	Ci	LLD	LLD	LLD	LLD
C-14	Ci	NA	NA	6.00E-05	NA
Total for Period:		5.59E-02	5.67E-03	5.21E-03	1.79E-03

Table 21 (continued)
Liquid Effluents - Nuclides Released
Batch Releases

Nuclides	Unit	1st Qtr 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995
Tritium	Ci	2.55E+01	3.09E+01	7.40E+01	3.58E+01
Dissolved and Entrained Gases					
Kr-85	Ci	LLD[a]	LLD[a]	9.08E-04	LLD[a]
Xe-131m	Ci	LLD	LLD	4.01E-04	LLD
Xe-133	Ci	6.50E-05	3.57E-04	6.69E-03	1.49E-03
Xe-135	Ci	LLD	LLD	2.71E-06	7.20E-06
Total for Period:		6.50E-05	3.57E-04	8.00E-03	1.50E-03

Table 21 (continued)
Liquid Effluents - Nuclides Released
Continuous Releases

Nuclides	Unit	1st Qtr 1995	2nd Qtr 1995	3rd Qtr 1995	4th Qtr 1995
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	9.26E-06
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	9.26E-06
Tritium	Ci	1.15E-01	2.30E-01	1.58E-01	8.44E-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
Xe133m	Ci	LLD	LLD	LLD	LLD
Xe-135	Ci	LLD	LLD	LLD	LLD
Total for Period		N/A	N/A	N/A	N/A

Table 21 (continued)
Liquid Effluents - Nuclides Released[a]

Na-24	<2.0E-08 µCi/ml	Sn-113	<2.8E-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-133	<2.1E-08 µCi/ml
Zr-97	<2.5E-08 µCi/ml	I-135	<1.7E-07 µCi/ml
Nb-95	<2.1E-08 µCi/ml	Kr-85	<6.2E-06 µCi/ml
Mo-99	<1.6E-07 µCi/ml	Xe-131m	<7.7E-07 µCi/ml
Tc-99m	<1.8E-08 µCi/ml	Xe-133	<4.6E-08 µCi/ml
Ru-103	<2.2E-08 µCi/ml	Xe-133m	<1.6E-07 µCi/ml
Ag-110m	<2.5E-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) listed below. The largest LLD value is used for each radionuclide. LLDs are applicable to both batch and continous 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	6-month Period	Est. Total Error, %
a. Spent resins, filter sludges evaporator bottoms, etc.	m^3 Ci	9.16E+00 1.38E+01	2.5E+01 2.5E+01
b. Dry compressible waste, contaminated equip., etc.	m^3 Ci	1.23E+00 7.51E-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	1.76E+00 7.62E-01	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}	8.95E+00	2.50E+01
	Co^{58}	7.15E+00	2.50E+01
	Co^{60}	7.27E+00	2.50E+01
	Ni^{63}	1.25E+01	2.50E+01
	C^{14}	1.86E+00	2.50E+01
	Cs^{134}	1.09E+01	2.50E+01
	Cs^{137}	4.87E+01	2.50E+01
b. Dry compressible waste, contaminated equipment, etc.	Fe^{55}	1.45E+01	2.50E+01
	Co^{60}	3.17E+00	2.50E+01
	Ni^{63}	1.61E+00	2.50E+01
	Cs^{134}	9.76E+00	2.50E+01
	Cs^{137}	1.91E+01	2.50E+01
	Ba/La^{140}	4.55E+01	2.50E+01
	Sn^{113}	2.85E+00	2.50E+01
	Cr^{51}	1.81E+00	2.50E+01
c. None			
d. Cartridge filters	Fe^{55}	4.51E+01	2.50E+01
	Ni^{59}	1.76E+00	2.50E+01
	Ni^{63}	3.16E+01	2.50E+01
	Cs^{134}	9.86E+00	2.50E+01
	Cs^{137}	1.11E+01	2.50E+01

Table 22 (continued)
Solid Waste and Irradiated Fuel Shipments

3. Solid Waste Disposition

Number of Shipments:	2
Mode of Transportation:	Truck
Destination:	Barnwell - S.C.
Type of Container (Container Volume):	2 resin/filter HICs (7.18 m^3) buried
Number of Shipments:	5
Mode of Transportation:	Truck
Destination:	Scientific Ecology Group - Oak Ridge, TN
Type of Container (Container Volume):	a. Metal/Wood boxes of dry contaminated waste and metal (1.24 m^3) buried (1.02 m^3) estimated disposal volume after processing b. 1 resin/filter HIC (3.75 m^3) buried c. 7 steel resin liners (1.09 m^3) estimated disposal volume after processing

B. IRRADIATED FUEL SHIPMENTS

There were no shipments of irradiated fuel.

Table 23
Doses Due to Gaseous Releases
for January through December 1995

Maximum Individual doses due to I-131, H-3 and Particulates with Half-Lives Greater than 8 Days.

Whole Body Dose	3.94E-3 mrem
Significant Organ Dose	1.70E-2 mrem

Maximum Individual Dose Due to Noble Gas

Whole Body Dose	3.52E-3 mrad
Skin Dose	1.34E-2 mrad

Population Doses due to I-131, H-3, and Particulates with Half-Lives Greater than 8 Days.

Total Integrated Population Dose	5.06E-03 person-rem
Average Dose to Individual in Population	2.32E-06 mrem

Population Dose due to Noble Gas

Total Integrated Population Dose	8.24E-03 person-rem
Average Dose to Individual in Population	3.77E-06 mrem

Table 24
Doses Due To Liquid Releases
for January through December 1995

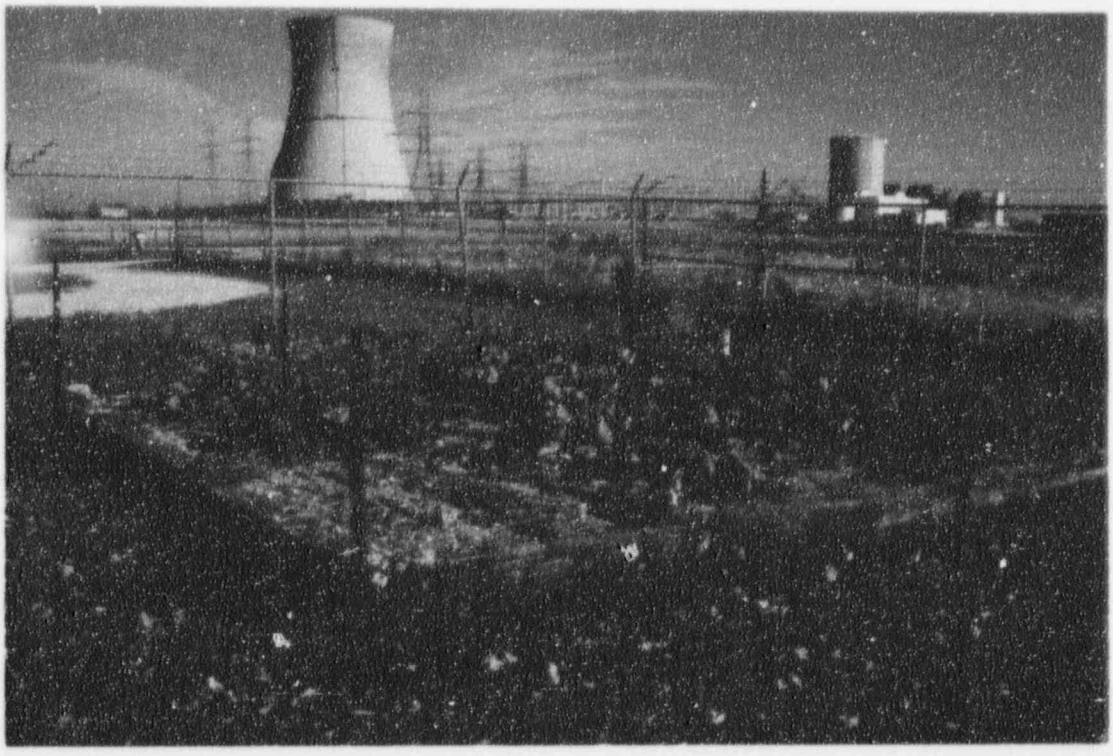
Maximum Individual Whole Body Dose	1.03E-01 mrem
Maximum Individual Significant Organ Dose	1.35E-01 mrem
Population Dose	
Total Integrated Population Dose	3.63E+00 person- rem
Average Dose to Individual	1.66E-03 mrem

Table 25
Annual Dose to the Most Exposed Member of the Public

	ANNUAL DOSE (mrem)	40CFR190 LIMIT (mrem)	PERCENT OF LIMIT
Whole Body Dose			
Noble Gas	352E-03		
Iodine,Tritium,Particulates	3.94E-03		
Liquid	1.03E-01		
Total Whole Body Dose	1.10E-01	25	4.42E-01
Thyroid Dose			
Iodine,Tritium,Particulates	1.70E-02	75	2.27E-02
Skin Dose			
Noble Gas	1.34E-02	25	5.36E-02
Significant Organ Dose (Liver)	1.35E-01	25	5.40E-01

Meteorological Data

Meteorological data on 3 1/2 inch microdisk for January 1 through December 31, 1995, 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. 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 the various 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 1995 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) yielding 2 kg/m^2.

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 1995 census:

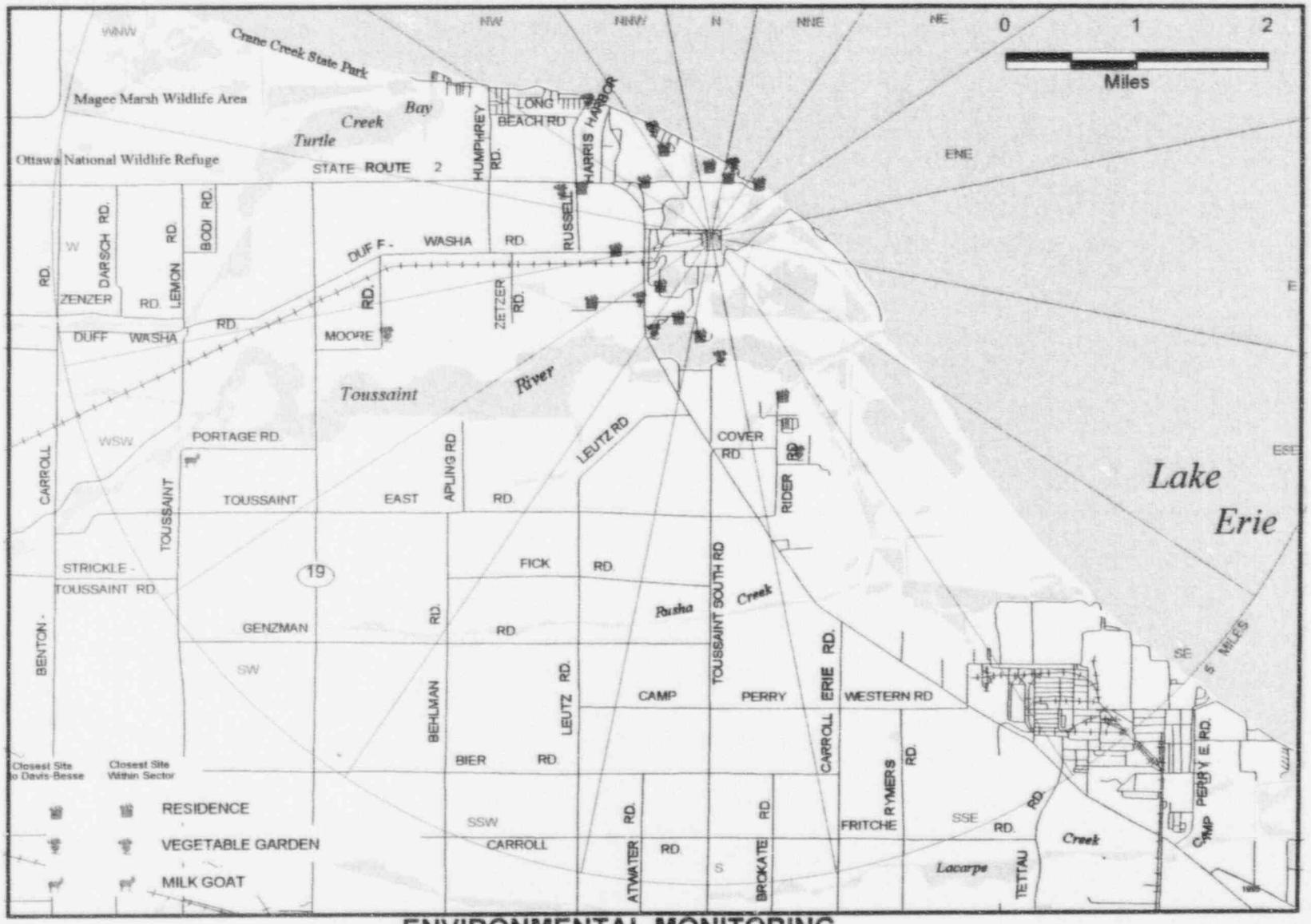
- **NNE Sector** - A garden at 880 meters was identified, this garden was not present during the 1994 census.
- **SSE Sector** - The garden at 2880 meters was replaced by a garden at 2820 meters.
- **S Sector** - The garden at 3280 meters was replaced by a garden at 1410 meters.
- **SSW Sector** - The garden at 1560 meters was replaced with a garden at 1220 meters
- **SW Sector** - The garden at 1050 meters was replaced with a garden at 960 meters.
- **WSW Sector** - A milk goat is present at 7010 meter which was not identified during the 1994 Census.
- **W Sector** - The garden at 1660 meters was replaced with a garden at 980 meters
- **NNW Sector** - The garden at 1370 meters was replaced with a garden at 1210 meters.

The critical receptor identified by the 1995 Land Use Census is a child for the vegetation pathway at 880 meters in the NNE sector. This is a change from the 1994 Land Use Census.

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

Table 26
Closest Exposure Pathways Present in 1995

Sector	Distance from Station (meters)	Closest Pathways
N	880	Inhalation Ground Exposure Plume Exposure
NNE	870	Inhalation Ground Exposure Plume Exposure
NNE**	880	Vegetation
NE	900	Inhalation Ground Exposure Plume Exposure
ENE, E, ESE, SE	N/A	Located over Lake Erie
SSE	2010	Inhalation Ground Exposure Plume Exposure
SSE**	2820	Vegetation
S	1070	Inhalation Ground Exposure Plume Exposure
S**	1410	Vegetation
SSW	980	Inhalation Ground Exposure Plume Exposure
SSW**	1220	Vegetation
SW**	960	Inhalation Ground Exposure Plume Exposure Vegetation

** Changes since 1994

Table 26 (continued)
Closest Exposure Pathways Present in 1995

Sector	Distance from Station (meters)	Closest Pathways
WSW	1620	Inhalation Ground Exposure Plume Exposure
WSW	4270	Vegetation
WSW**	7010	Goat Milk
W**	980	Inhalation Ground Exposure Plume Exposure Vegetation
WNW	1730	Inhalation Ground Exposure Plume Exposure
WNW	1750	Vegetation
NW	1100	Inhalation Ground Exposure Plume Exposure
NW	2340	Vegetation
NNW**	1210	Inhalation Ground Exposure Plume Exposure Vegetation

** Changes since 1994

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	880	Inhalation	Child	9.15E-07	8.40E-09
NNE**	880	Vegetation	Child	1.24E-06	1.44E-08
NE	900	Inhalation	Child	1.26E-06	1.58E-08
ENE*	---	---	---	---	---
E*	---	---	---	---	---
ESE*	---	---	---	---	---
SE*	---	---	---	---	---
SSE**	2820	Vegetation	Child	7.02E-08	8.36E-10
S**	1410	Vegetation	Child	1.27E-07	2.57E-09
SSW**	1220	Vegetation	Child	1.57E-07	3.46E-09
SW**	960	Vegetation	Child	3.18E-07	5.78E-09
WSW	7010	Goat Milk	Infant	3.60E-08	2.03E-10
W**	980	Vegetation	Child	6.21E-07	9.58E-09
WNW	1750	Vegetation	Child	1.46E-07	1.72E-09
NW	2340	Vegetation	Child	6.84E-08	5.61E-10
NNW**	1210	Vegetation	Child	2.70E-07	1.92E-09

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

** Changes since 1994.

Non-Radiological Environmental Programs

Meteorological Monitoring

Introduction

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 Davis-Besse Technical Specifications 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 Environmental Activities Program, and groups such as Plant Operations, Plant Security, Materials Management, Industrial Safety Program, Toledo and Cleveland Service Dispatch, Legal Affairs, 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 Environmental Activities Program uses meteorological data for chemical spill response activities, marsh management studies, and waste water 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, such as humidity percentages and barometric pressures for sensitive plant components. 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. Service Dispatch in both Toledo and Cleveland utilize Davis-Besse weather satellite imagery for planning and scheduling maintenance crews to restore power to customers more efficiently. Legal Affairs uses climatological data for their investigation into adverse weather accidents to the plant and personnel; and company employees and members of the surrounding community rely on daily weather forecasts provided by meteorological personnel at Davis-Besse to better plan their daily and routine work activities.

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	Barometric Pressure

Meteorological Instrumentation

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

According to the Davis-Besse Nuclear Power Station Operating License, Appendix A, Technical Specification, a minimum of six instruments are required to be operable at the two lower levels (75 m and 10 m) to measure temperature, wind speed, and wind direction. During 1995, annual data recovery for all required instruments were 99.3 percent. The annual data recovery for all other measured parameters was 99.2 percent. Minor losses of data occurred during routine instrument maintenance, calibration, and data validation.

* International Great Lakes Data - 1955

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.

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 11/84 and VAX computer system. This is a dedicated line. If a failure occurs at any point between the primary meteorological system and the control room the second data logger in the primary shelter can be utilized by the control room. 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 VAX 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 1995. Tables 28 through 30, discussed in this section, can be found on pages 122 through 141.

Wind Speed and Wind Direction

The maximum wind speeds for 1995 were 46.17 mph for the 100m level on October 5, 42.52 mph for the 75m level on November 27, and 33.90 mph for the 10m level on October 5. 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 1995 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 1995 was 49.71 F. The maximum temperature was 96.77°F on July 14 with the minimum temperature of -0.14°F on February 12. Yearly average differential temperatures were -0.25°F(100m), and -0.16°F(75m). Maximum differential temperatures for 100m and 75m levels were 8.00°F on March 7 (100m), and 7.99°F on October 17 (75m). Minimum differential temperatures for 100m and 75m levels were -3.90°F on August 17 (100m) and -3.44°F on August 17 (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 1995 are provided in Table 29. These data are measured at the 10 meter level. The average dew point temperature was 41.89°F with a maximum dew point temperature of 80.70°F on July 15. 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 -9.25°F on February 9. Average relative humidity is 76.14 for the year. The maximum relative humidity was 100.00 percent on December 29. The minimum relative humidity was 0.24 percent on April 11. 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 1995 are given in Table 29. Total precipitation for the year was 24.64 inches. The maximum monthly precipitation total was 3.42 inches in May. The minimum was 0.66 inches recorded in February. 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.

Satellite Imagery

A state-of-the-art satellite weather system was installed in 1994. This system consists of a remote one-meter satellite dish, a host computer receiver which has four remote user connections, with a real-time weather access. The weather satellite is 22,000 miles out in space, with a geosyncronous orbit situated over North America. Data from the satellite is fed to WSI corporation for base map interpretation and then sent to a communication satellite which then sends the completed imagery to the receiving satellite dish at Toledo Edison. Data from this site can then be sent to all four remote users; two users in the Toledo area and two in Cleveland. This advanced weather station allows meteorological staff to forecast adverse weather conditions long before they arrive. This enables planners in Service Dispatch to keep needed crews available if adverse weather conditions dictate; or to send home unneeded crews if a projected storm tracks out of the customer service area. Load Dispatch utilizes the weather system to get an idea where the peak and low electricity loads will be either during very hot days or very cold ones. High winds, solar flares, freeze lines, wind chill, min-max temperatures and graphic imagery can all be obtained digitally through this weather satellite system, allowing better planning by staff and better service to customers; saving time and money as well.

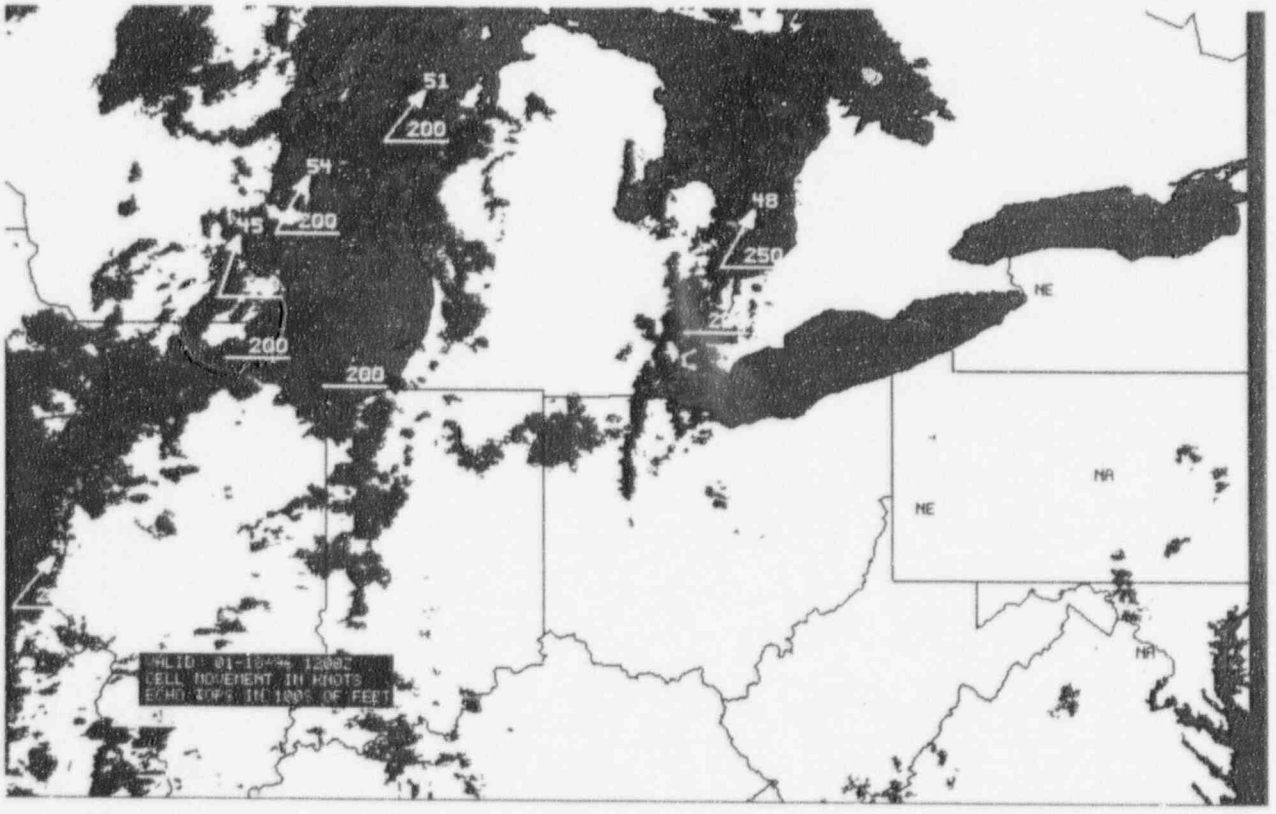


Table 28
Summary of Meteorological Data Recovery For The Davis-Besse Nuclear Power Station
January 1, 1995 through December 31, 1995

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1995
100M Wind Speed	100	98.36	95.03	94.72	100	98.75	98.92	99.19	100	100	100	98.79	98.65
100m Wind Direction	100	98.36	95.03	99.72	100	98.75	98.92	87.10	100	100	100	98.79	98.04
75m Wind Speed	100	98.36	95.03	97.22	100	98.75	98.92	99.19	100	100	100	98.79	98.86
75m Wind Direction	100	98.36	95.03	99.72	100	98.61	98.92	99.19	100	100	100	98.79	99.05
10m Wind Speed	100	100	100	99.72	100	98.75	98.92	99.29	100	100	100	98.79	99.61
10m Wind Direction	100	100	100	99.72	100	95.83	98.92	99.19	100	100	100	98.79	98.37
10m Ambient Air Temp	100	100	100	99.72	100	98.75	98.92	99.19	100	100	100	99.46	99.67
10m Dew Point Temp	100	100	100	97.78	99.46	96.39	98.92	96.77	100	100	97.08	99.46	98.82
Delta T (100m-10m)	100	100	100	99.72	100	98.75	98.92	99.19	100	100	100	99.46	99.67
Delta T (75m-10m)	100	100	100	99.72	100	98.75	98.92	99.19	100	100	100	99.46	99.67
Joint 100m winds and Delta T (100m-10m)	100	98.36	95.03	94.72	100	98.75	98.92	87.10	100	100	100	98.79	97.63
Joint 75m winds and Delta T (100m-10m)	100	98.36	95.03	97.22	100	98.61	98.92	99.19	100	100	100	98.79	98.85
Joint 10m winds and Delta T (75m-10)	100	100	100	99.72	100	95.83	98.92	99.19	100	100	100	98.79	99.37

*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.

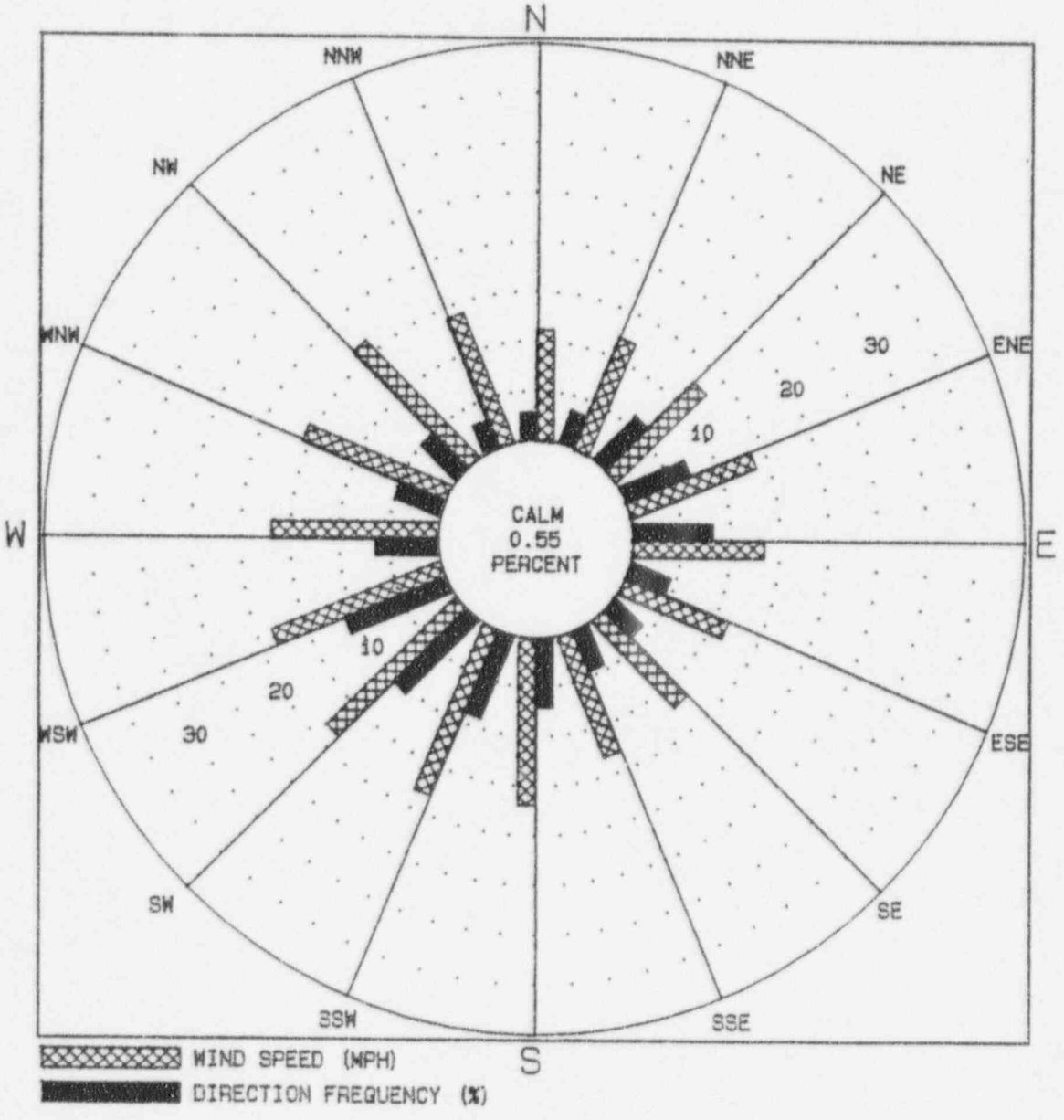
Table 29
Summary of Meteorological Data Measured at Davis-Besse Nuclear Power Station
January 1, 1995 through December 31, 1995

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1995
100M WIND													
Max Speed (mph)	36.06	37.12	39.20	42.41	43.52	27.63	27.67	25.47	27.22	46.17	44.68	38.53	46.17
Date of Max Speed	31	04	20	27	14	07	06	31	27	05	27	19	10/05
Min Speed (mph)	1.08	4.34	0.74	1.52	1.80	1.87	1.57	1.13	1.16	2.47	0.38	1.32	0.38
Date of Min Speed	10	23	02	14	05	13	08	27	04	31	29	31	11/29
Ave Wind Speed	18.10	18.26	14.90	17.59	16.12	11.84	13.99	11.27	13.32	19.19	18.67	18.17	15.94
75M WIND													
Max Speed (mph)	33.43	35.34	36.08	40.82	41.52	26.74	33.32	23.81	25.01	41.76	42.52	35.03	42.52
Date of Max Speed	31	04	20	27	14	07	13	31	22	05	27	09	11/27
Min Speed (mph)	1.22	3.06	0.74	2.77	1.81	1.66	1.60	1.34	1.54	2.54	0.71	1.77	0.71
Date of Min Speed	10	23	03	01	05	12	08	29	02	31	29	31	11/29
Ave Wind Speed	16.81	16.89	13.79	16.69	14.80	10.89	12.73	10.46	12.18	17.30	17.17	16.52	14.68
10M WIND													
Max Speed (mph)	25.85	26.94	23.68	31.42	31.88	21.02	28.14	17.46	20.99	33.90	33.72	32.06	33.90
Date of Max Speed	02	11	20	27	14	07	13	31	07	05	27	19	10/05
Min Speed (mph)	1.37	1.40	0.70	1.74	1.67	0.89	1.15	1.01	1.00	1.16	0.60	1.89	0.60
Date of Min Speed	27	23	02	01	24	02	30	02	27	02	29	02	11/29
Ave Wind Speed	11.71	11.57	8.98	12.03	10.02	7.08	7.54	6.59	7.50	9.94	10.87	11.36	9.59

Table 29 (continued)
Summary of Meteorological Data Measured at
Davis-Besse Nuclear Power Station
January 1, 1995 through December 31, 1995

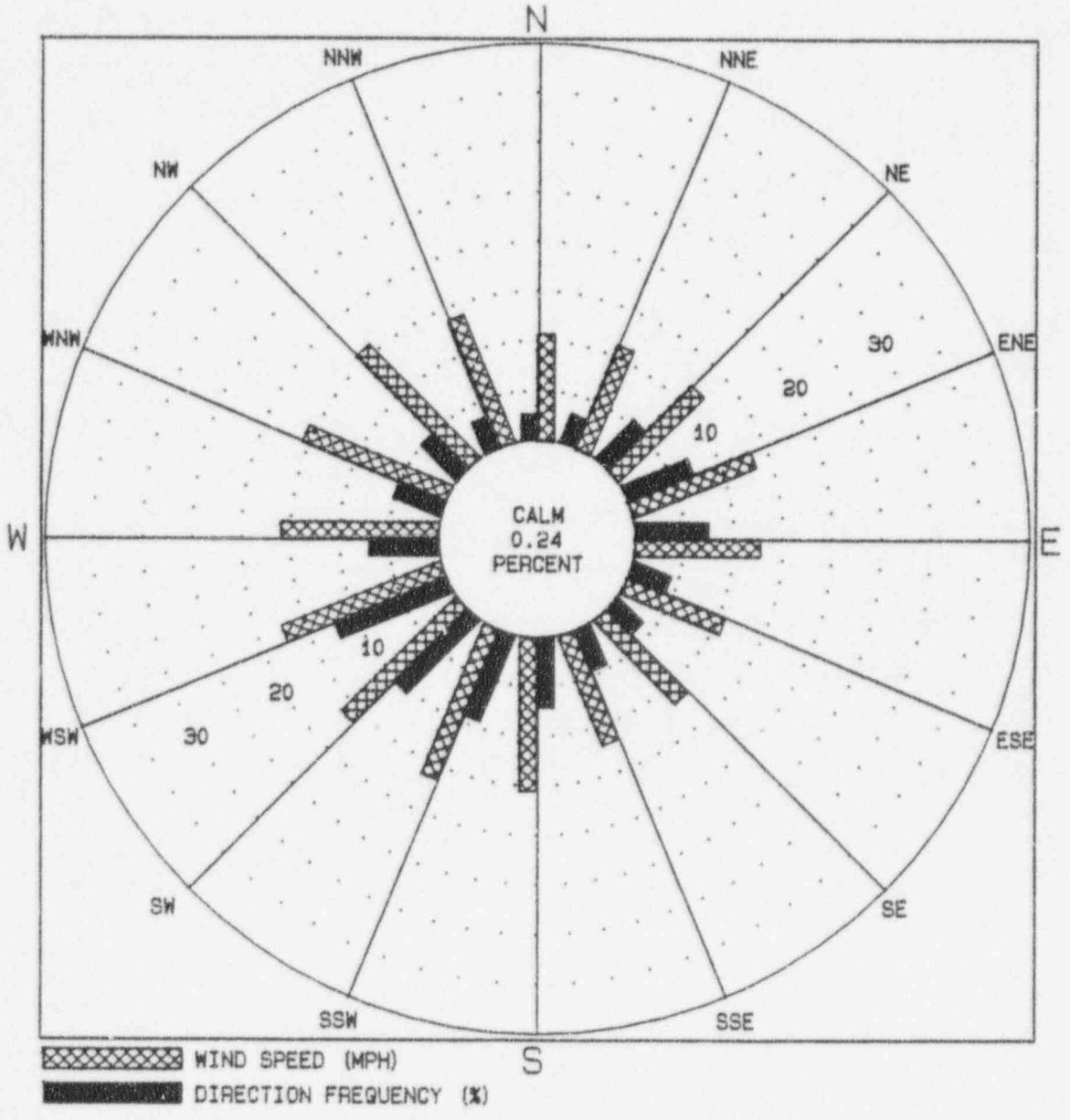
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1995
10M AMBIENT TEMP													
Max (F)	64.34	46.82	68.39	75.43	80.10	91.93	96.77	90.80	85.33	80.08	69.18	54.51	96.77
Date of Max	14	23	13	18	23	19	14	13	06	13	02	03	07/14
Min (F)	2.11	-0.14	16.74	17.79	44.67	52.41	54.89	61.15	37.56	35.30	21.61	1.92	-0.14
Date of Min	05	12	02	05	06	08	08	23	23	17	05	09	02/12
Ave Temp	27.43	25.64	38.72	44.29	58.83	70.02	74.04	75.67	62.27	55.02	36.37	26.89	49.71
10M DEW POINT TEMP													
Mean (F)	24.10	20.24	30.81	35.23	48.35	61.74	64.59	67.52	52.55	44.52	30.41	22.23	41.89
Max (F)	57.33	42.93	57.44	65.08	68.10	73.50	80.70	80.10	69.19	64.21	61.94	50.69	80.70
Date of Max	14	15	07	18	28	19	15	13	12	06	02	03	07/15
Min (F)	0.54	-9.25	9.73	8.33	29.69	38.97	26.62	2.85	28.20	22.67	15.70	-1.42	-9.25
Date of Min	05	05	02	04	21	13	04	13	22	04	15	09	02/05
PRECIPITATION													
Total (inches)	2.14	0.66	1.32	2.64	3.42	1.48	3.21	2.20	0.82	3.66	2.40	0.69	24.64
Max. in One Day	.92	.40	1.01	.70	1.37	.74	.87	.83	.44	2.36	1.00	.38	2.36
Date	19	27	7	8	29	26	15	17	20	5	10	13	10/5

Figure 32
Wind Rose Annual Average 100M



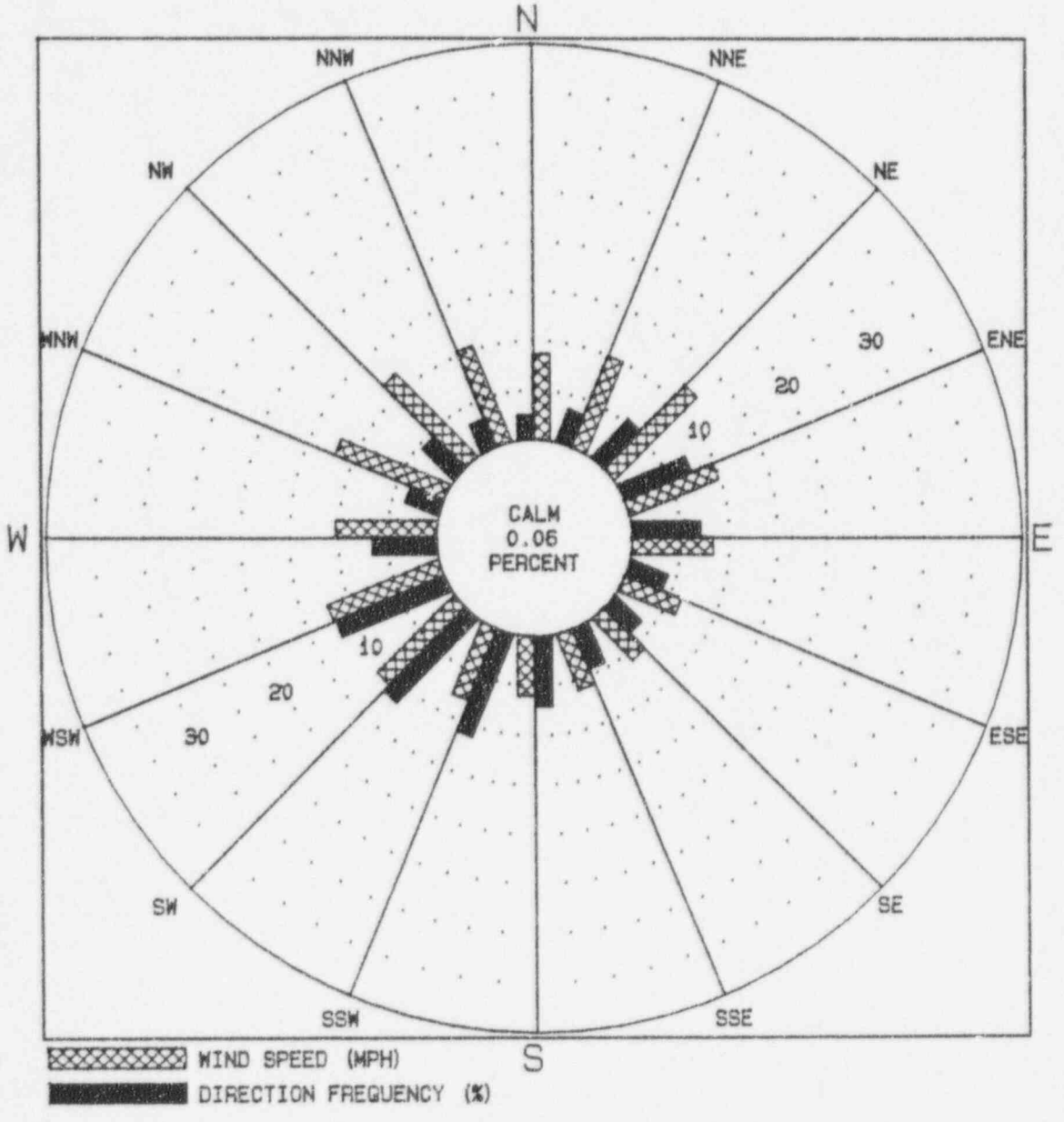
DAVIS-BESSE
ANNUAL 1995
100M LEVEL

Figure 33
Wind Rose Annual Average 75M



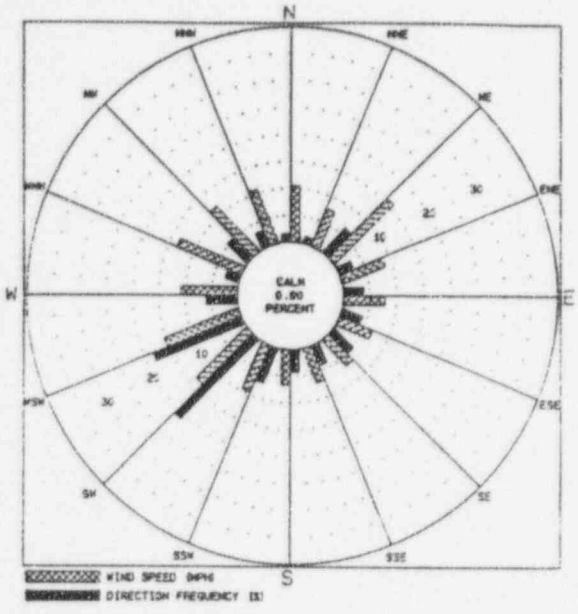
DAVIS-BESSE
ANNUAL 1995
75M LEVEL

Figure 34
Wind Rose Annual Average 10M

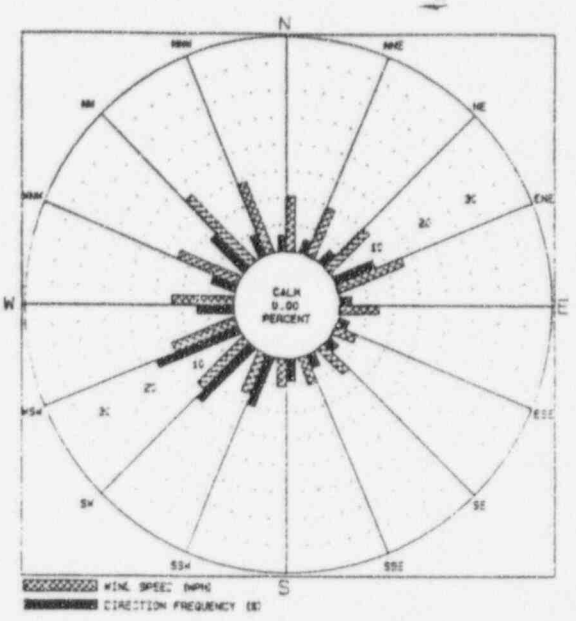


DAVIS-BESSE
ANNUAL 1995
10M LEVEL

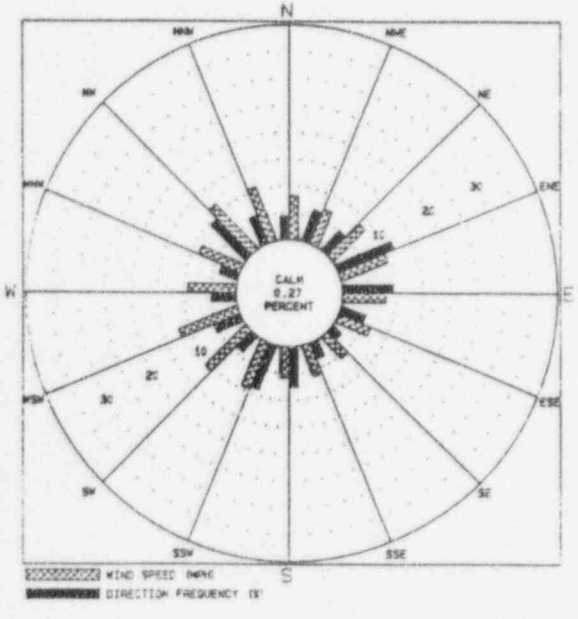
Figure 35
Wind Rose Monthly Average 100M



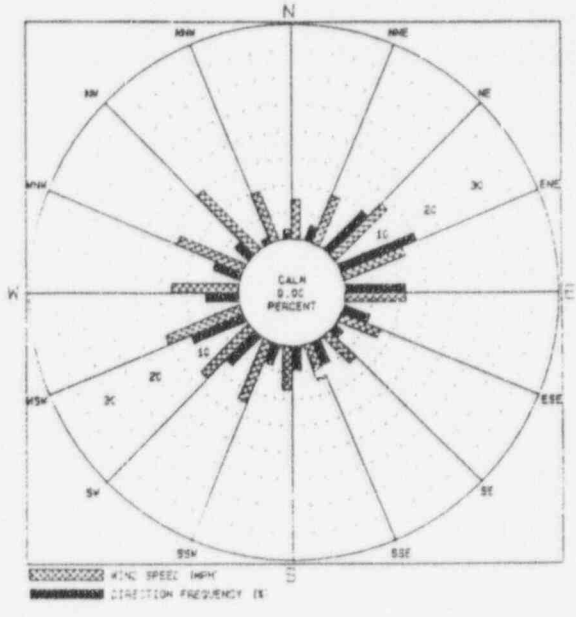
DAVIS-BESSE
JANUARY 1995
10M LEVEL



DAVIS-BESSE
FEBRUARY 1995
10M LEVEL

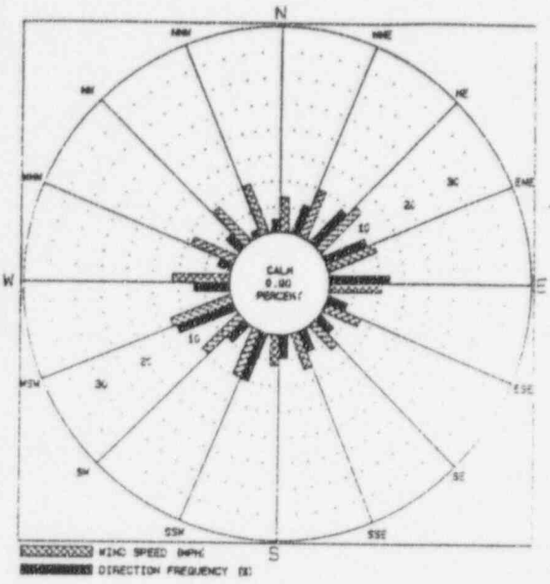


DAVIS-BESSE
MARCH 1995
10M LEVEL

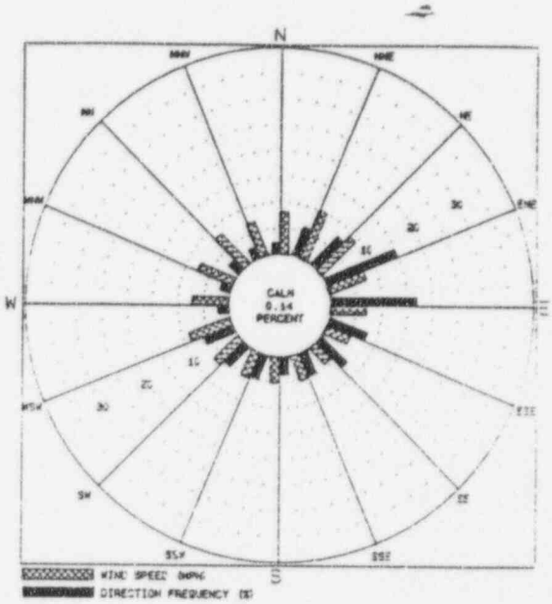


DAVIS-BESSE
APRIL 1995
10M LEVEL

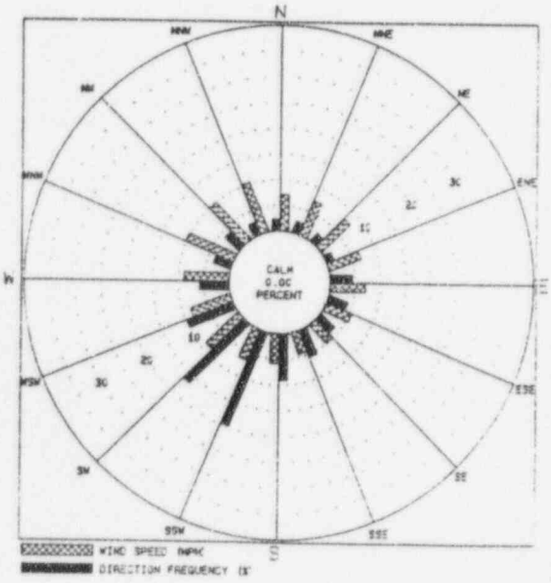
Figure 35 (continued)
Wind Rose Monthly Average 100M



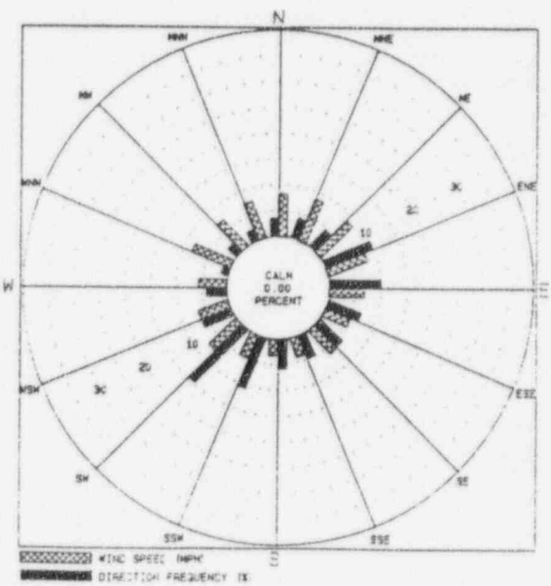
DAVIS-BESSE
MAY 1995
10M LEVEL



DAVIS-BESSE
JUNE 1995
10M LEVEL

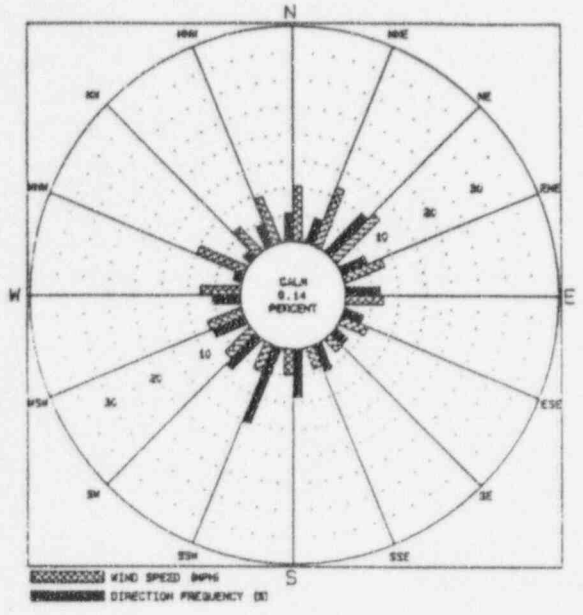


DAVIS-BESSE
JULY 1995
10M LEVEL

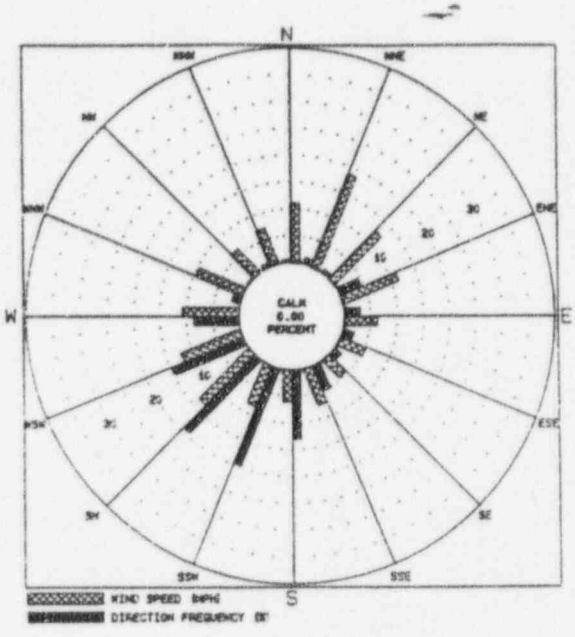


DAVIS-BESSE
AUGUST 1995
10M LEVEL

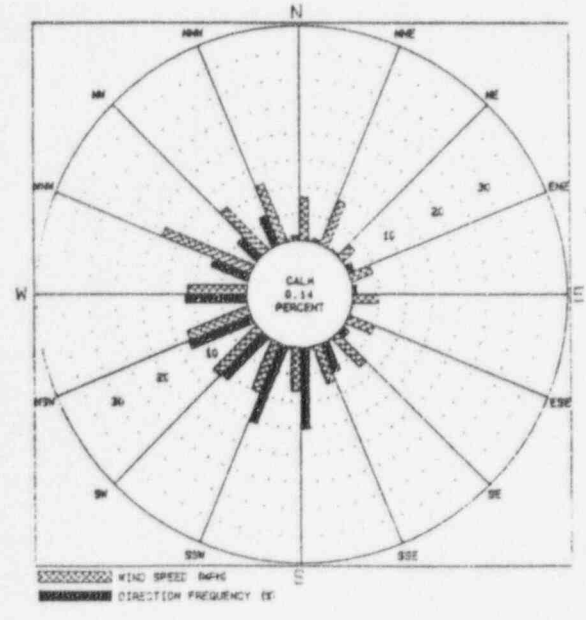
Figure 35 (continued)
Wind Rose Monthly Average 100M



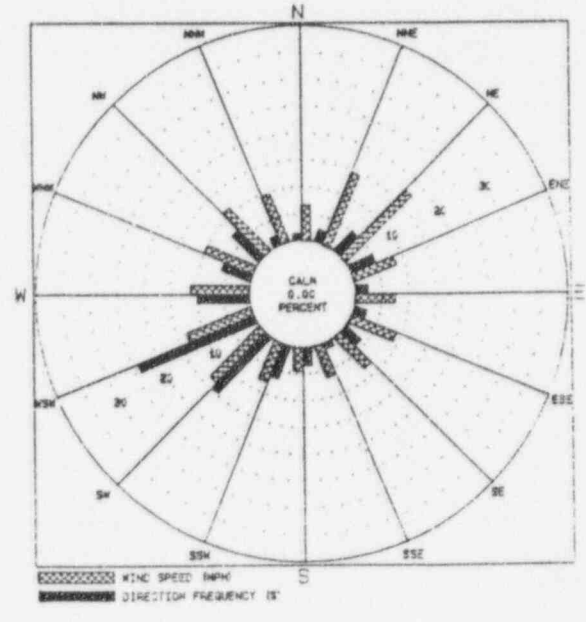
DAVIS-BESSE
SEPTEMBER 1995
10M LEVEL



DAVIS-BESSE
OCTOBER 1995
10M LEVEL

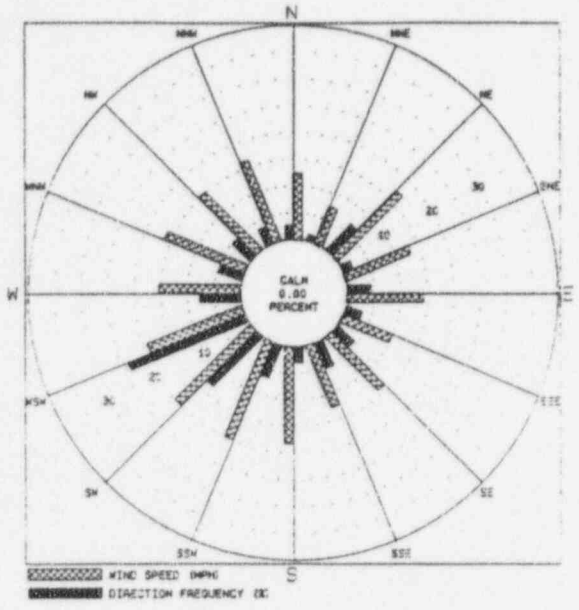


DAVIS-BESSE
NOVEMBER 1995
10M LEVEL

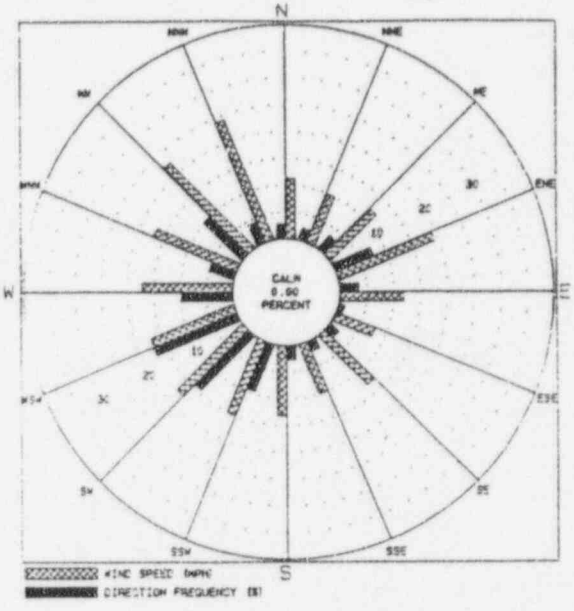


DAVIS-BESSE
DECEMBER 1995
10M LEVEL

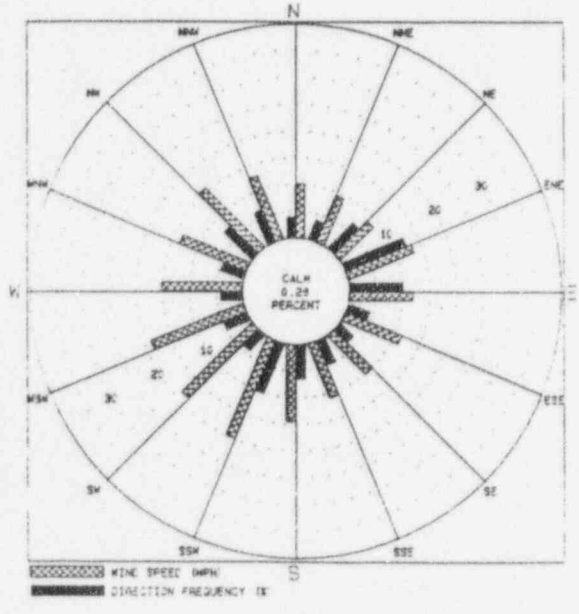
Figure 36
Wind Rose Monthly Average 75M



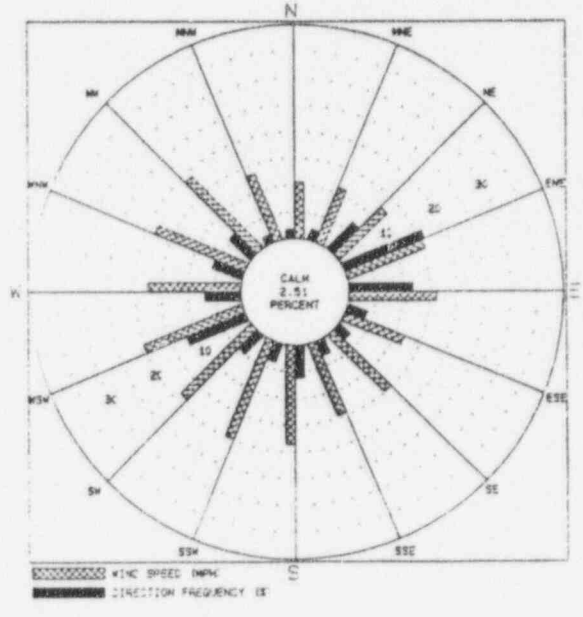
DAVIS-BESSE
JANUARY 1995
75M LEVEL



DAVIS-BESSE
FEBRUARY 1995
75M LEVEL

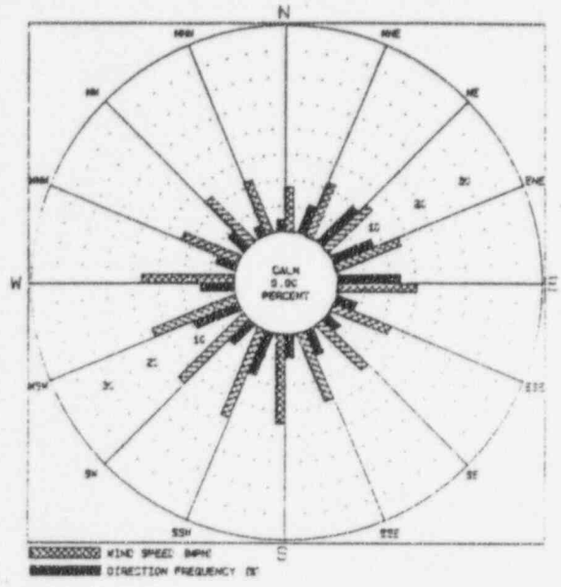


DAVIS-BESSE
MARCH 1995
75M LEVEL

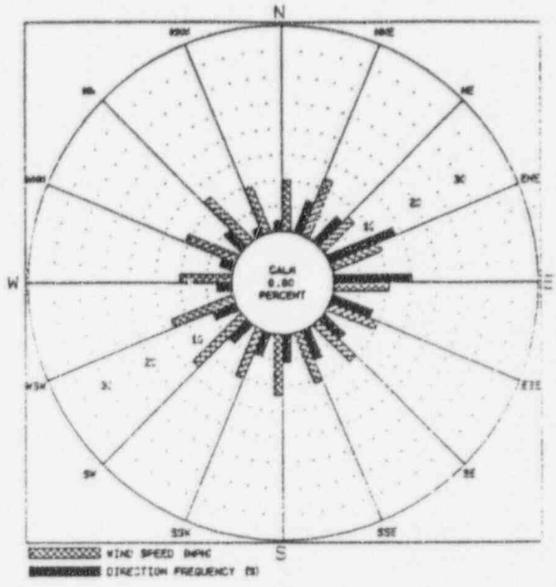


DAVIS-BESSE
APRIL 1995
75M LEVEL

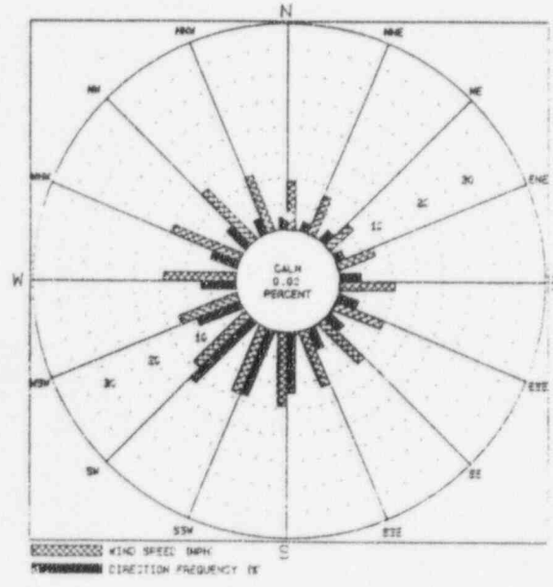
Figure 36 (continued)
Wind Rose Monthly Average 75M



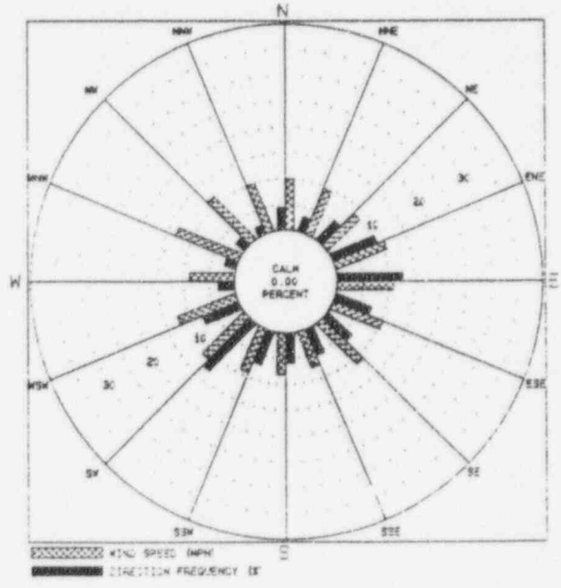
DAVIS-BESSE
MAY 1995
75M LEVEL



DAVIS-BESSE
JUNE 1995
75M LEVEL

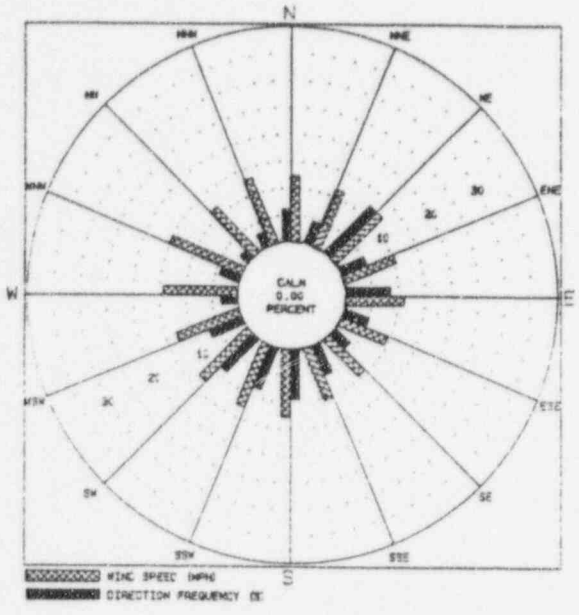


DAVIS-BESSE
JULY 1995
75M LEVEL

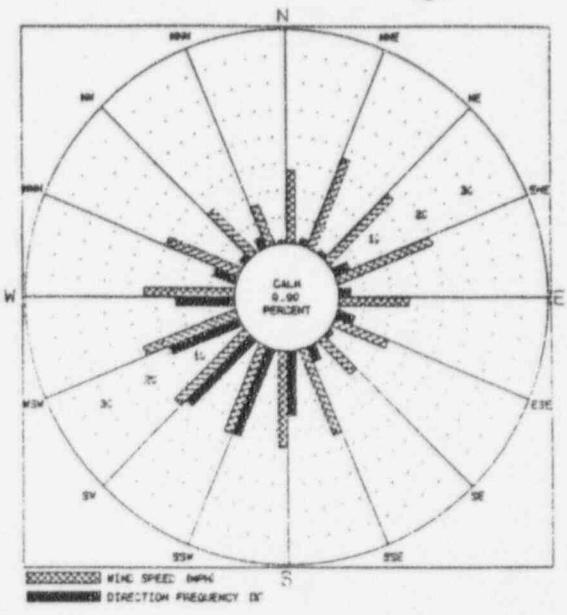


DAVIS-BESSE
AUGUST 1995
75M LEVEL

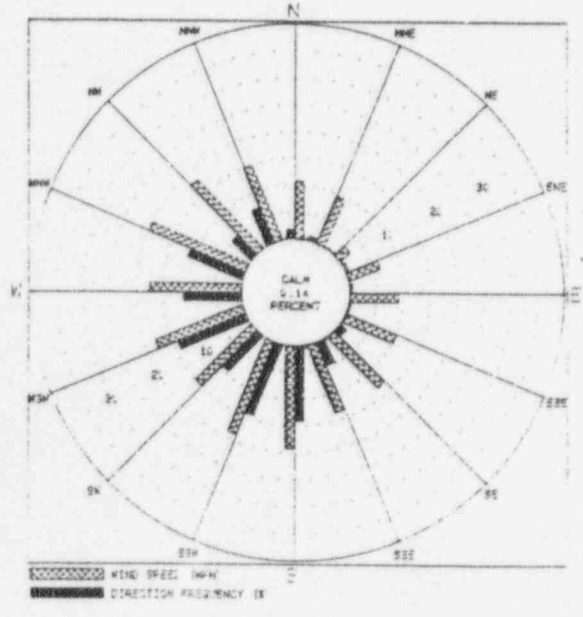
Figure 36 (continued)
Wind Rose Monthly Average 75M



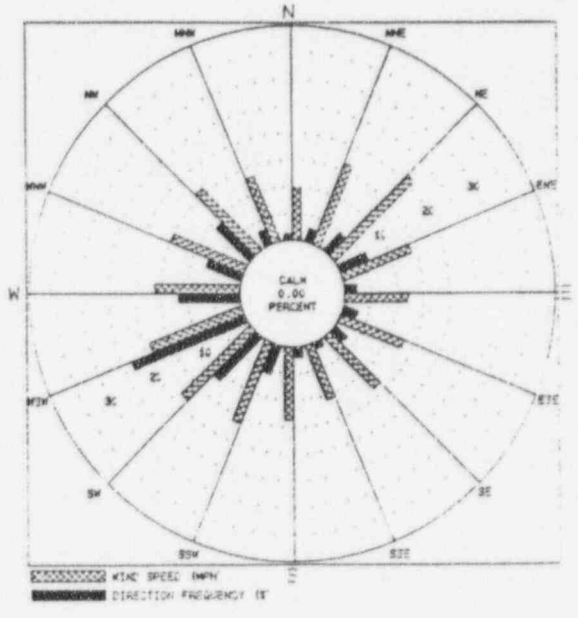
DAVIS-BESSE
SEPTEMBER 1995
75M LEVEL



DAVIS-BESSE
OCTOBER 1995
75M LEVEL

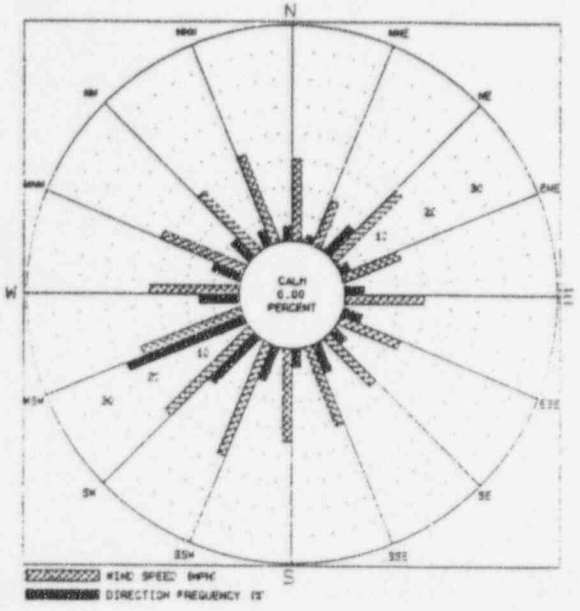


DAVIS-BESSE
NOVEMBER 1995
75M LEVEL

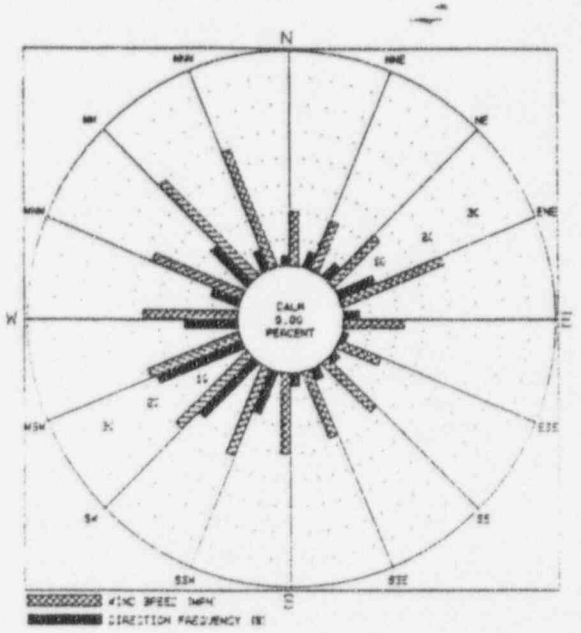


DAVIS-BESSE
DECEMBER 1995
75M LEVEL

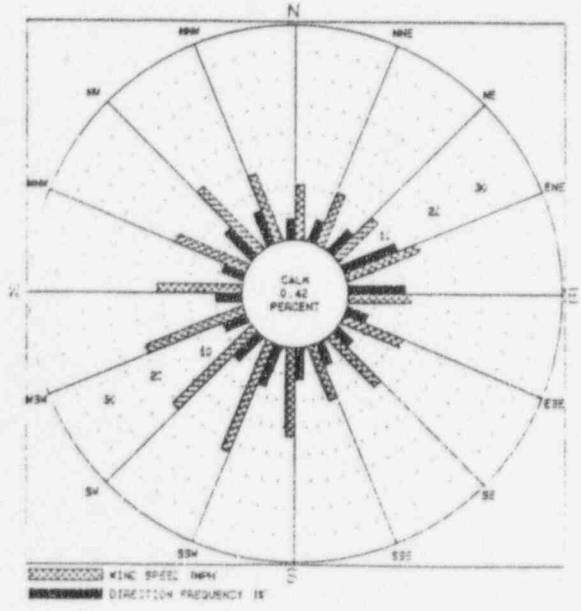
Figure 37
Wind Rose Monthly Average 10M



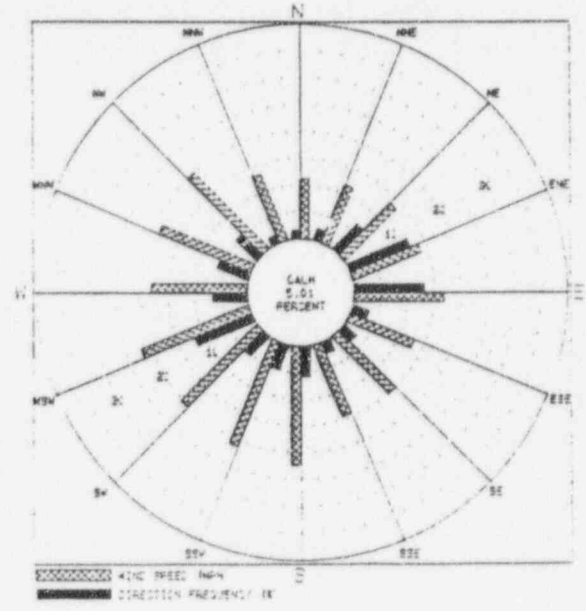
DAVIS-BESSE
JANUARY 1995
100M LEVEL



DAVIS-BESSE
FEBRUARY 1995
100M LEVEL

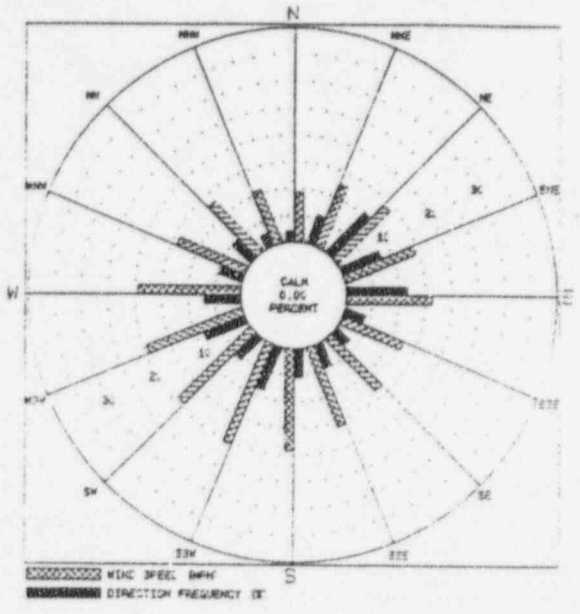


DAVIS-BESSE
MARCH 1995
100M LEVEL

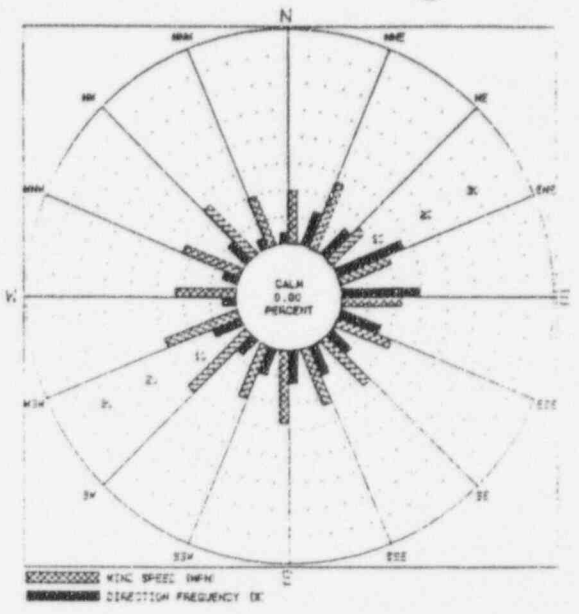


DAVIS-BESSE
APRIL 1995
100M LEVEL

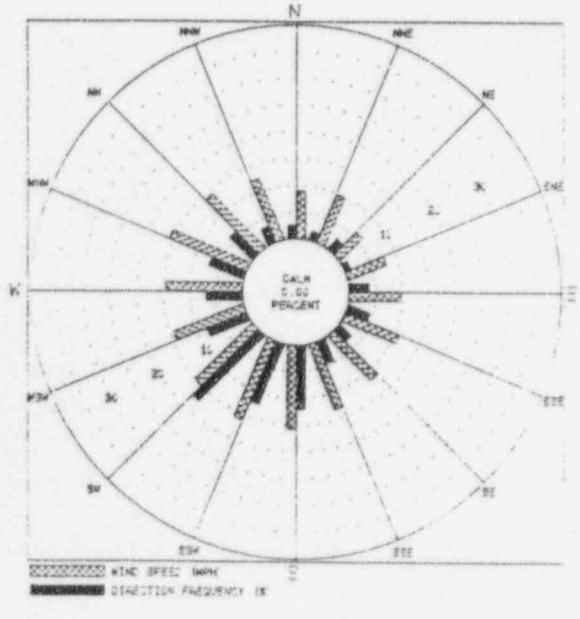
Figure 37 (continued)
Wind Rose Monthly Average 10M



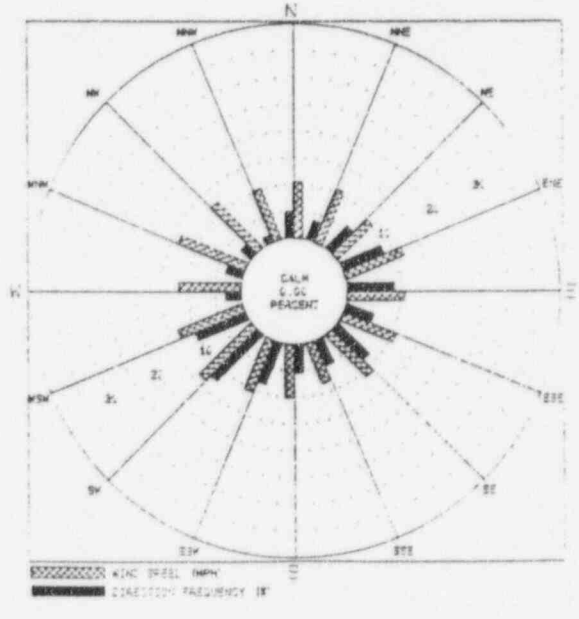
DAVIS-BESSE
MAY 1995
100M LEVEL



DAVIS-BESSE
JUNE 1995
100M LEVEL

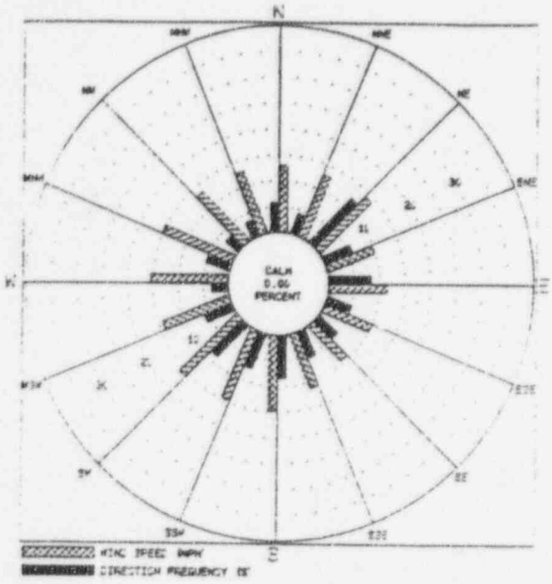


DAVIS-BESSE
JULY 1995
100M LEVEL

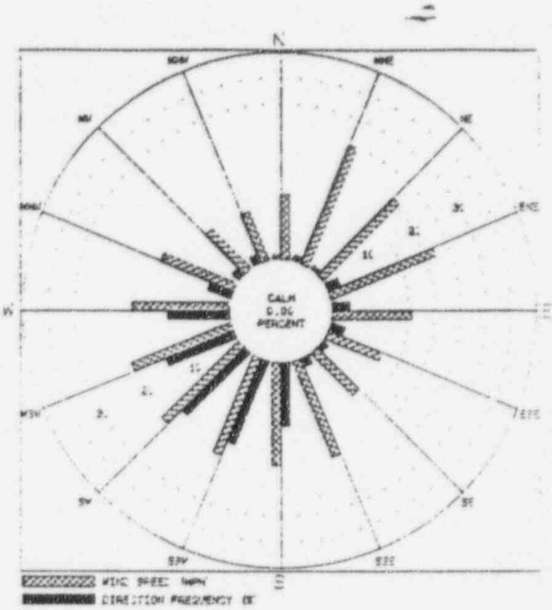


DAVIS-BESSE
AUGUST 1995
100M LEVEL

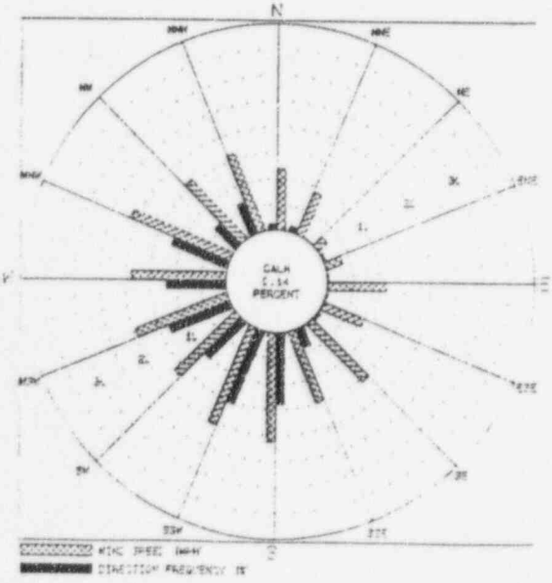
Figure 37 (continued)
Wind Rose Monthly Average 10M



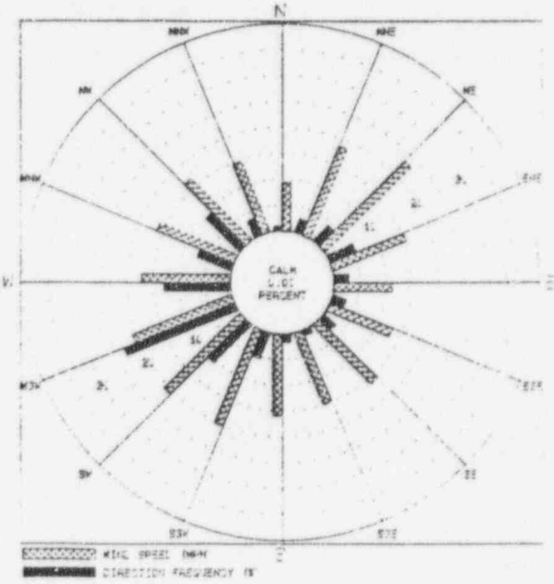
DAVIS-BESSE
SEPTEMBER 1995
100M LEVEL



DAVIS-BESSE
OCTOBER 1995
100M LEVEL



DAVIS-BESSE
NOVEMBER 1995
100M LEVEL



DAVIS-BESSE
DECEMBER 1995
100M LEVEL

Table 30
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * **25-JAN-96
TIME OF DAY: 13:29:47

PROGRAM: JFD VERSION: F77-1.0

******** DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 95
DATA PERIOD EXAMINED: 1/ 1/ 95 - 12/ 31/ 95

*** 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	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
3.50- 7.49	2	2	0	0	2	0	0	1	0	0	0	0	0	2	4	1	14
7.50-12.49	1	0	0	0	0	0	0	0	0	0	0	0	0	4	13	0	18
12.50-18.49	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	4
18.50-24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	0	7
>24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	2	0	0	2	0	0	2	0	0	0	0	0	11	23	1	44

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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.50- 7.49	6	3	0	0	0	0	0	0	0	0	0	0	2	2	3	0	16
7.50-12.49	8	1	0	0	0	1	0	0	0	4	0	1	0	4	6	8	33
12.50-18.49	0	0	1	2	0	0	0	0	0	0	0	1	3	4	7	2	20
18.50-24.49	0	0	0	3	0	0	0	0	0	0	0	2	2	2	2	0	11
>24.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	14	4	1	5	0	1	0	0	0	4	0	4	7	12	18	10	80

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * **25-JAN-96
PROGRAM: JFD VERSION: F77-1.0 TIME OF DAY: 13:29:47

******** DAVIS-BESSE 75-10 DT, NO BACKUP ********
DATA PERIOD EXAMINED: 1/ 1/ 95 - 12/ 31/ 95 SITE IDENTIFIER: 95

*** 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	0	0	0	0	0	0	0	1	0	1
3.50- 7.49	6	7	0	0	0	0	0	1	5	5	0	1	3	1	1	10	40
7.50-12.49	9	3	9	8	10	1	1	0	1	3	9	14	4	4	6	20	102
12.50-18.49	3	3	6	1	1	0	0	0	0	1	3	6	11	7	16	3	61
18.50-24.49	0	0	0	1	0	0	0	0	0	0	3	10	3	4	5	0	26
>24.49	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	5
TOTAL	18	13	15	10	11	1	1	1	6	9	15	33	24	16	29	33	235

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																	2
1.01- 3.49	8	3	5	15	14	9	10	5	18	6	8	12	4	4	3	3	127
3.50- 7.49	44	54	72	117	114	92	54	62	51	94	94	52	31	20	30	30	1011
7.50-12.49	73	100	155	259	206	64	49	40	57	149	195	220	118	71	92	68	1916
12.50-18.49	39	59	104	66	63	1	3	10	16	82	162	286	120	61	76	56	1204
18.50-24.49	1	9	43	34	4	0	0	2	4	8	84	118	16	22	30	20	395
>24.49	0	7	16	2	0	0	0	0	0	0	21	22	1	7	3	1	80
TOTAL	165	232	395	493	401	166	116	119	146	339	564	710	290	185	234	178	4735

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT *** * **25-JAN-96
TIME OF DAY: 13:29:47

PROGRAM: JFD VERSION: F77-1.0

******** DAVIS-BESSE 75-10 DT, NO BACKUP ******** SITE IDENTIFIER: 95
DATA PERIOD EXAMINED: 1/ 1/ 95 - 12/ 31/ 95

*** 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																	2
1.01- 3.49	3	6	4	6	16	20	23	31	48	16	9	13	12	7	6	6	226
3.50- 7.49	20	24	20	49	89	112	90	98	165	186	77	63	59	27	18	11	1108
7.50-12.49	6	15	17	40	41	25	24	49	54	130	150	139	87	44	38	34	893
12.50-18.49	2	2	1	15	5	2	2	4	12	53	46	37	28	20	26	3	258
18.50-24.49	1	0	0	8	0	0	0	0	2	6	21	7	3	3	0	0	51
>24.49	0	1	2	0	1	0	0	0	0	0	1	3	1	2	0	0	11
TOTAL	32	48	44	118	152	159	139	182	281	391	304	262	190	103	88	54	2549

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																	0
1.01- 3.49	1	0	2	2	1	5	19	24	49	34	18	25	14	1	3	0	198
3.50- 7.49	1	3	6	8	13	19	28	44	81	134	85	28	40	6	1	0	497
7.50-12.49	0	1	3	8	6	4	5	4	1	17	6	12	6	8	0	4	85
12.50-18.49	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	3
18.50-24.49	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	4	11	18	20	28	52	72	131	186	109	66	60	15	4	5	783

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT ***

* **25-JAN-96
TIME OF DAY: 13:29:47

PROGRAM: JFD VERSION: F77-1.0

******** DAVIS-BESSE 75-10 DT, NO BACKUP ********

SITE IDENTIFIER: 95

DATA PERIOD EXAMINED: 1/ 1/ 95 - 12/ 31/ 95

*** ANNUAL ***

STABILITY CLASS G

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	1	1	5	1	1	3	11	10	18	15	8	8	0	6	4	95
3.50- 7.49	1	1	2	9	12	9	10	11	36	44	12	6	4	1	0	0	158
7.50-12.49	0	0	0	4	3	12	4	1	0	1	0	0	0	0	0	0	25
12.50-18.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.50-24.49	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	4	2	3	18	16	22	17	23	46	63	27	14	12	1	6	4	279

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	FNE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM																	5
1.01- 3.49	15	10	12	28	32	35	55	72	125	74	50	58	38	12	19	13	648
3.50- 7.49	80	94	100	183	230	232	182	217	338	463	268	150	139	59	57	52	2844
7.50-12.49	97	120	184	319	266	107	83	94	113	304	360	386	215	135	155	134	3072
12.50-18.49	44	64	112	84	69	3	5	14	28	137	211	331	162	94	127	65	1550
18.50-24.49	2	9	43	46	4	0	0	2	6	14	108	137	24	34	41	20	490
>24.49	0	8	18	2	1	0	0	0	0	0	22	27	5	9	3	1	96
TOTAL	238	305	469	662	602	377	325	399	610	992	1019	1089	583	343	402	285	8705

Table 30 (continued)
Joint Frequency Distribution by Stability Class

*** * *** DAVIS-BESSE ENVIRONMENTAL COMPLIANCE UNIT ***

* **25-JAN-96
TIME OF DAY: 13:29:47

PROGRAM: JFD VERSION: F77-1.0

SITE IDENTIFIER: 95

******** DAVIS-BESSE 75-10 DT, NO BACKUP ********
DATA PERIOD EXAMINED: 1/ 1/ 95 - 12/ 31/ 95 *** ANNUAL ***

STABILITY BASED ON: DELTA T BETWEEN 250.0 AND 35.0 FEET
WIND MEASURED AT: 35.0 FEET
WIND THRESHOLD AT: 1.00 MPH

TOTAL NUMBER OF OBSERVATIONS: 8760
TOTAL NUMBER OF VALID OBSERVATIONS: 8705
TOTAL NUMBER OF MISSING OBSERVATIONS: 55
PERCENT DATA RECOVERY FOR THIS PERIOD: 99.4 %
MEAN WIND SPEED FOR THIS PERIOD: 9.6 MPH
TOTAL NUMBER OF OBSERVATIONS WITH BACKUP DATA: 0

PERCENTAGE OCCURRENCE OF STABILITY CLASSES

A	B	C	D	E	F	G
0.51	0.92	2.70	54.39	29.28	8.99	3.21

DISTRIBUTION OF WIND DIRECTION VS STABILITY

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
A	3	2	0	0	2	0	0	2	0	0	0	0	0	11	23	1	0
B	14	4	1	5	0	1	0	0	0	4	0	4	7	12	18	10	0
C	18	13	15	10	11	1	1	1	6	9	15	33	24	16	29	33	0
D	165	232	395	493	401	166	116	119	146	339	564	710	290	185	234	178	2
E	32	48	44	118	152	159	139	182	281	391	304	262	190	103	88	54	2
F	2	4	11	18	20	28	52	72	131	186	109	66	60	15	4	5	0
G	4	2	3	18	16	22	17	23	46	63	27	14	18	1	6	4	1
TOTAL	238	305	469	662	602	377	325	399	610	992	1019	1089	583	343	402	285	5

Land and Wetlands Management

Navarre Marsh

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 lake front with a sand bar 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, including the Ottawa National Wildlife Refuge, the Ohio Department of Natural Resources (ODNR), and the Black Swamp Bird Observatory to preserve and enhance existing habitat, to gain knowledge through ongoing research, and to help educate the public about the importance of native wetlands.

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

Navarre is also home tc wildlife that is typical of much of the marshland in this area, including deer, fox, coyote, muskrats, rabbits, woodchucks, 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 a record 38 eaglets fledged in Ohio in 1995.

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.

Davis-Besse opened the Navarre Marsh for public tour for the first time ever in observance of International Migratory Bird Day. About 350 members of the public took part in shuttle van tours, which included a bluebird trail demonstration, a banded bird demonstration given by the Black Swamp Bird Observatory, and a look at Davis-Besse's American Bald Eagle pair. Back to the Wild, Inc., a licensed animal rehabilitator, joined the activities and brought several live animals as part of the program.

Ohio's first Federal Junior Duck Stamp Art Contest was hosted by Davis-Besse. Young Ohio artists in grades K-12 submitted nearly 600 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 being sent to Washington, D. C. to compete with all state winners for best in the nation, which will be featured on the 1995-1996 Junior Duck Stamp.

Davis-Besse also hosted a Volunteer Eagle Watchers Workshop and a Waterfowl Identification Seminar, both of which were sponsored by the Ohio Division of Wildlife.

Land Management - Habitat Improvement

Prairie Planting

In a cooperative effort with the local chapter of Pheasants Forever, a 10 acre section of land outside of the marsh was carefully prepared and planted with four species of prairie grass and seven species of wildflowers. The area had in the past, consisted of weeds and nuisance grasses which provided little or no wildlife habitat, and had to be mowed about twice a year. The cost of the prairie establishment was minimal, with Pheasants Forever providing the prairie grass seed and the use of a no till grain drill, and future costs of repeated turf grass and weed mowing will be eliminated.

Aesthetically, the prairie will pay for itself as well. Not only are prairie grasses and forbs better to look at, they provide better habitat, improve water quality, and prevent soil erosion. Employees and neighboring landowners will be treated to ever-changing colors and shapes as the prairie evolves throughout the growing season.

Other areas of Davis-Besse are being considered for prairie establishment in the coming years.

Metzger Marsh Wetland Restoration Project

Davis-Besse pledged partnership with Ducks Unlimited, the Ohio Division of Wildlife, and the Ottawa National Wildlife Refuge in the restoration of 908 acres of vital wetlands in the Metzger Marsh by donating electrical service to be supplied to the marsh pump, boring costs, overhead costs and the cost of a transformer for the pump that will be used to drain the marsh.

The $4.2 million project is the largest ever undertaken by Ducks Unlimited, and includes a 7,700 feet of lakefront dike which allows for precise water level control which is essential for good marsh management.

The restoration of former wetlands and the preservation of existing wetlands is good environmental stewardship, since Ohio wetlands have been reduced by over 90% since the 1800's.

Water Treatment

Water Treatment Plant Operation

Description

The Davis-Besse Nuclear Power Station uses Lake Erie as a water source for its water treatment plant. The lake water is treated with chlorine, lime, and other chemicals to make the water clean and safe for consumption. This water may also be further treated to produce high purity water which is used by many of the Station's cooling systems.

Operation of the water treatment plant is monitored by the Ohio Environmental Protection Agency (OEPA) and the Ohio Department of Health. The operation of the facility is reviewed by a Public Water Supply certified operator. Activities at the water treatment plant are conducted in compliance with the Safe Drinking Water Act and the regulations for public water supply as set forth by the OEPA.

Monthly operational reports, required by the OEPA, are completed by Toledo Edison personnel and submitted to the agency. These reports contain sample dates and analytical results, which are compared to standards established by the OEPA. Operational data are also reviewed for compliance with the limits set by the OEPA. As a further means of monitoring water quality, drinking water is sampled annually for pesticides, herbicides, heavy metals (such as chromium, arsenic, mercury, lead) and quarterly certain organic chemicals. The health and safety of the water treatment plant operators and other site personnel is ensured through weekly housekeeping inspections of the facility.

Treatment System

Raw water from Lake Erie enters an intake structure, then passes through traveling screens which remove debris and large particles. 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.

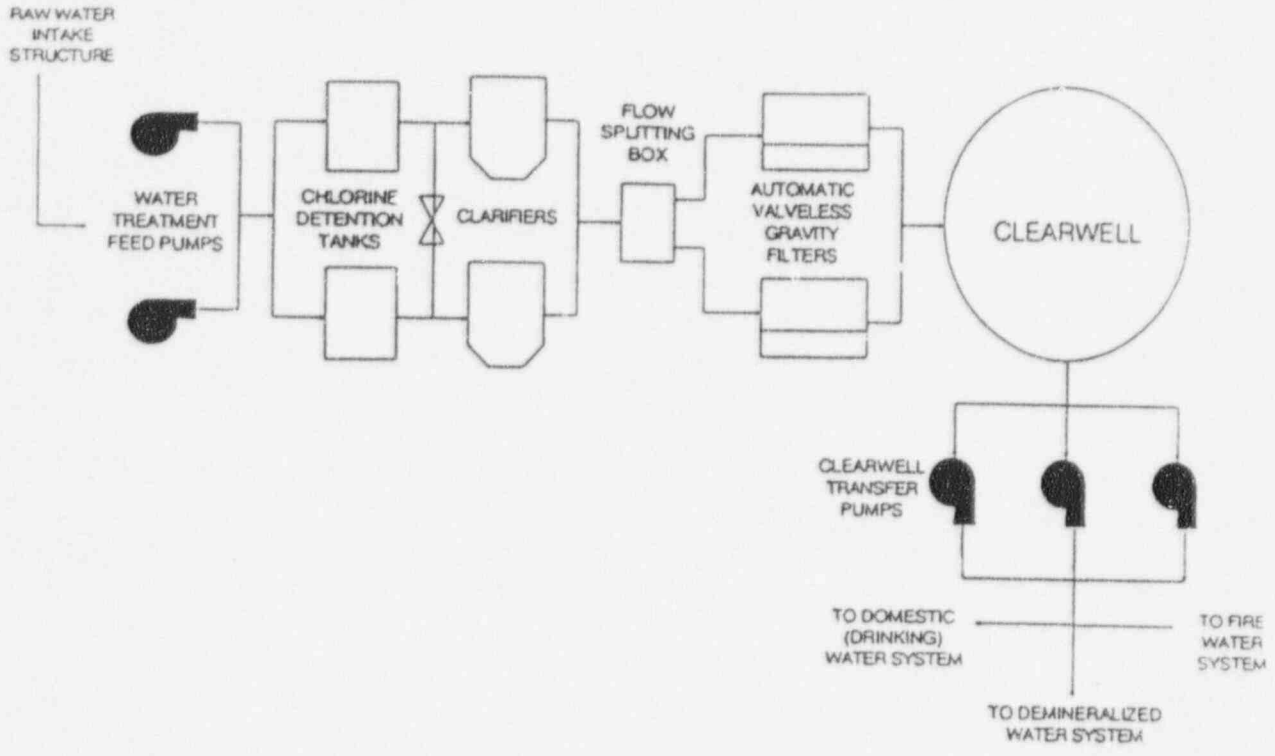


Figure 38: At Davis-Besse, raw water is drawn into the water treatment plant and processed to make drinking water and water for plant systems.

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 and odor and improves the taste 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 fire water, demineralized water, and also drinking water.

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 1988 and was discovered in Lake Erie in 1989. Zebra mussels are prolific breeders which rapidly colonize an area by secreting byssal threads which 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 yet 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).

Monitoring

The Zebra Mussel Monitoring Program has been in place since April, 1990. The program involves the collection of several types of samples which are observed for the presence of adult zebra mussels or the free-swimming larval forms, veligers. The frequency of sampling is determined by lake water temperature. Samples are taken when the lake temperature is above 12°C since this is the temperature above which spawning may occur. At temperatures above 18°C, spawning conditions are most favorable, and more frequent samples are taken. Weather data and water temperatures are also recorded to determine their effects on veliger/mussel population.

Water samples are collected in the station's intake forebay. These samples are collected using a plankton net sampler: a net support system with a straining bucket used for plankton-size (microscopic) organisms including veligers. One milliliter from each sample is observed under a microscope to check for the presence of veligers to determine the average number of veligers per liter.

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 mussels decline, mussel population declines correspondingly.

Wastewater Treatment Plant Operation

The wastewater treatment plant (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, organic materials are digested by microorganisms which are provided with a source of oxygen. This is accomplished through 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 1995 Wastewater Treatment Plant Operations

Two comminutors were purchased and installed in March 1995. One comminutor was placed at the inlet to each wastewater treatment plant to grind/shred incoming materials, which prevents clogging of the surge tank pumps. This has greatly improved the facility's operability and reduced maintenance costs.

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 * ED. 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 by the fifteenth day 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.

1995 NPDES Summary

During 1995, there was one noncompliance event on March 16 and 17, when the pH at Outfall 001 reached 9.07 standard units (S.U.). This resulted due to high Lake Erie intake water pH values at or near the discharge limit of 9.00 S.U.

Chemical Waste Management

Introduction

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 is 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 1995, the Davis-Besse Nuclear Power Station generated 1,620 pounds of hazardous wastes, which represents a 74% reduction from 1994. There were 3,070 gallons of non-hazardous waste oil generated in 1995, a 32% reduction from 1994. Additionally, approximately 1,200 gallons of oil filters and solid oily debris were generated during 1995. Additionally, 2,500 gallons of water containing small amounts of diesel fuel oil from a minor on-site diesel fuel oil leak were disposed as non-hazardous regulated waste.

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.

- **Testing of Waste Oil**

  The majority of waste oil generated at Davis-Besse is not disposed of, but is removed to a recycling facility for energy recovery. Before removal for recycling, the oil is tested to ensure that it is nonhazardous. Waste oil that contains less than 1,000 parts per million of halogens and has a flash point above 140°F is considered to be nonhazardous waste.

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 1995.

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, decontaimination 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. Approximately 15 kilograms of PCBs were disposed of in 1995.

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 very 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 and Centerior Energy have implemented several 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 % for disposal cost MSW. Additionally, joint partnership agreements with yard waste compositors have been developed for yard and lawn waste recycling.

Other programs include paper, cardboard , aluminum cans, used tires, and metals recycling or recovery. Greater than 58 tons of paper and greater than 9 tons of corrugated cardboard were recycled in 1995, which would have otherwise been placed in a landfill. Additionally, approximately 2500 pounds of aluminum soft drink cans are collected on site for the Boy Scouts to recycle. 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 program 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's Midwest Laboratory participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of International Intercomparison and Teledyne testing of TLD's, as well as, in-house spikes, blanks and duplicates. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only. Please refer to March, June, September and December progress reports for information.

January, 1995 through December, 1995

Appendix A

Interlaboratory Comparison Program Results

Teledyne's Midwest Laboratory (formerly Hazleton Environmental Sciences) 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 know 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 is conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for Thermoluminescent Dosimeters (TLDs), since 1976 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. 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.

Attachment A lists acceptance criteria for "spiked" samples.

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

12-31-95

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	>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-64[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. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media[a].

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L[b] Teledyne Results ±2 Sigma[c]	EPA Result[d] 1s, N=1	Control Limits
STW-723	WATER	Jan, 1995	Sr-89	17.7 ± 1.5	20.0 ± 5.0	11.3 - 28.7
STW-723	WATER	Jan, 1995	Sr-90	13.7 ± 0.6	15.0 ± 5.0	6.3 - 23.7
STW-724	WATER	Jan, 1995	Gr. Alpha	4.3 ± 0.6	5.0 ± 5.0	0.0 - 13.7
STW-724	WATER	Jan, 1995	Gr. Beta	4.7 ± 0.6	5.0 ± 5.0	0.0 - 13.7
STW-725	WATER	Feb, 1995	I-131	99.0 ± 4.4	100.0 ± 10.0	82.7 - 117.3
STW-726	WATER	Feb, 1995	Ra-226	19.2 ± 0.4	19.1 ± 2.9	14.1 - 24.1
STW-726	WATER	Feb, 1995	Ra-228	19.2 ± 2.0	20.0 ± 5.0	11.3 - 28.7
STW-726	WATER	Feb, 1995	Uranium	24.9 ± 0.2	25.5 ± 3.0	20.3 - 30.7
STW-727	WATER	Mar, 1995	H-3	7,460.0 ± 87.2	7,435.0 ± 744.0	6,144.2 - 8,725.8
STW-728	WATER	Mar, 1995	Pu-239	11.0 ± 0.6	11.1 ± 1.1	9.2 - 13.0
STW-729	WATER	Apr, 1995	Gr. Alpha	41.7 ± 0.6	47.5 ± 11.9	26.9 - 68.1
STW-729	WATER	Apr, 1995	Ra-226	13.4 ± 0.5	14.9 ± 2.2	11.1 - 18.7
STW-729	WATER	Apr, 1995	Ra-228	13.1 ± 2.4	15.8 ± 4.0	8.9 - 22.7
STW-729	WATER	Apr, 1995	Uranium	9.5 ± 0.6	10.0 ± 3.0	4.8 - 15.2
STW-730	WATER	Apr, 1995	Co-60	29.0 ± 1.7	29.0 ± 5.0	20.3 - 37.7
STW-730	WATER	Apr, 1995	Cs-134	17.3 ± 1.2	20.0 ± 5.0	11.3 - 28.7
STW-730	WATER	Apr, 1995	Cs-137	11.0 ± 1.0	11.0 ± 5.0	2.3 - 19.7
STW-730	WATER	Apr, 1995	Gr. Beta	74.8 ± 3.2	86.6 ± 10.0	69.3 - 103.9
STW-730	WATER	Apr, 1995	Sr-89	17.0 ± 0.0	20.0 ± 5.0	11.3 - 28.7
STW-730	WATER	Apr, 1995	Sr-90	12.7 ± 1.2	15.0 ± 5.0	6.3 - 23.7
STW-732	WATER	Jun, 1995	Ra-226	14.7 ± 0.3	14.8 ± 2.2	11.0 - 18.6
STW-732	WATER	Jun, 1995	Ra-228	11.9 ± 0.6	15.0 ± 3.8	8.4 - 21.6
STW-732	WATER	Jun, 1995	Uranium	13.9 ± 0.3	15.2 ± 3.0	10.0 - 20.4
STW-735	WATER	Jul, 1995	Gr. Alpha	16.4 ± 2.4	27.5 ± 6.9	15.5 - 39.5
STW-735	WATER	Jul, 1995	Gr. Beta	16.8 ± 1.0	19.4 ± 5.0	10.7 - 28.1
STW-736	WATER	Aug, 1995	H-3	4,773.7 ± 49.9	4,872.0 ± 487.0	4,027.1 - 5,716.9

[a] Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the environmental sample crosscheck program operated by the Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency (EPA), Las Vegas, Neveda.

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

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

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
2nd International Intercomparison						
115-2	CaF_2: Mn Bulb	Apr, 1976	Field	17.0 ± 1.9	17.1	16.4 ± 7.7
115-2	CaF_2: Mn Bulb	Apr, 1976	Lab	20.8 ± 4.1	21.3	18.6 ± 7.6
Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (HASL), New York, new York, and the School of Public Health of the University of Texas, Houston, Texas.						
3rd International Intercomparison						
115-3	CaF_2: Mn Bulb	Jun, 1977	Field	30.7 ± 3.2	34.9 ± 4.8	31.5 ± 3.0
115-3	CaF_2: Mn Bulb	Jun, 1977	Lab	89.6 ± 6.4	91.7 ± 14.6	86.2 ± 24.0
Third International Intercomparison of Environmental Dosimeters conducted in the summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.						
4th International Intercomparison						
115-4	CaF_2: Mn Bulb	Jun, 1979	Field	14.1 ± 1.1	14.1 ± 1.4	16.0 ± 9.0
115-4	CaF_2: Mn Bulb	Jun, 1979	Lab, High	40.4 ± 1.4	45.8 ± 9.2	43.9 ± 13.2
115-4	CaF_2: Mn Bulb	Jun, 1979	Lab, Low	9.8 ± 1.3	12.2 ± 2.4	12.0 ± 7.4
Fourth International Intercomparison of Environmental Dosimeters conducted in the summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.						
5th International Intercomparison						
115-5A	CaF_2: Mn Bulb	Oct, 1980	Field	31.4 ± 1.8	30.0 ± 6.0	30.2 ± 14.6
115-5A	CaF_2: Mn Bulb	Oct, 1980	Lab, End	96.6 ± 5.8	88.4 ± 8.8	90.7 ± 31.2
115-5A	CaF_2: Mn Bulb	Oct, 1980	Lab, Start	77.4 ± 5.8	75.2 ± 7.6	75.8 ± 40.4
Fifth International Intercomparison of Environmental Dosimeters conducted in the fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and the Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.						
5th International Intercomparison						
115-5B	LiF-100 Chips	Oct, 1980	Field	30.3 ± 4.8	30.0 ± 6.0	30.2 ± 14.6
115-5B	LiF-100 Chips	Oct, 1980	Lab, End	85.4 ± 11.7	88.4 ± 8.8	90.7 ± 31.2
115-5B	LiF-100 Chips	Oct, 1980	Lab, Start	81.1 ± 7.4	75.2 ± 7.6	75.8 ± 40.4
Fifth International Intercomparison of Environmental Dosimeters conducted in the fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and the Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.						
6th International Intercomparison						
115-6						
Teledyne did not participate in the Sixth International Intercomparison of Environmental Dosimeters.						
7th International Intercomparison						
115-7A	LiF-100 Chips	Jun, 1984	Field	75.4 ± 2.6	75.8 ± 6.0	75.1 ± 29.8

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

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
115-7A	LiF-100 Chips	Jun, 1984	Lab, Co-60	80.0 ± 3.5	79.9 ± 4.0	77.9 ± 27.6
115-7A	LiF-100 Chips	Jun, 1984	Lab, Cs-137	66.6 ± 2.5	75.0 ± 3.8	73.0 ± 22.2
Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.						
7th International Intercomparison						
115-7B	LiF-100 Chips	Jun, 1984	Field	71.5 ± 2.6	75.8 ± 6.0	75.1 ± 29.8
115-7B	LiF-100 Chips	Jun, 1984	Lab, Co-60	84.8 ± 6.4	79.9 ± 4.0	77.9 ± 27.6
115-7B	LiF-100 Chips	Jun, 1984	Lab, Cs-137	78.8 ± 1.6	75.0 ± 3.8	73.0 ± 22.2
Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.						
7th International Intercomparison						
115-7C	$CaSO_4$: Dy Cards	Jun, 1984	Field	76.8 ± 2.7	75.8 ± 6.0	75.1 ± 29.8
115-7C	$CaSO_4$: Dy Cards	Jun, 1984	Lab, Co-60	82.5 ± 3.7	79.9 ± 4.0	77.9 ± 27.6
115-7C	$CaSO_4$: Dy Cards	Jun, 1984	Lab, Cs-137	79.0 ± 3.2	75.0 ± 3.8	73.0 ± 22.2
Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.						
8th International Intercomparison						
115-8A	LiF-100 Chips	Jan, 1986	Field, Site 1	29.5 ± 1.4	29.7 ± 1.5	28.9 ± 12.4
115-8A	LiF-100 Chips	Jan, 1986	Field, Site 2	11.3 ± 0.8	10.4 ± 0.5	10.1 ± 9.1
115-8A	LiF-100 Chips	Jan, 1986	Lab, Cs-137	13.7 ± 0.9	17.2 ± 0.9	16.2 ± 6.3
Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.						
8th International Intercomparison						
115-8B	LiF-100 Chips	Jan, 1986	Field, Site 1	32.3 ± 1.2	29.7 ± 1.5	28.9 ± 12.4
115-8B	LiF-100 Chips	Jan, 1986	Field, Site 2	9.0 ± 1.0	10.4 ± 0.5	10.1 ± 9.0
115-8B	LiF-100 Chips	Jan, 1986	Lab, Cs-137	15.8 ± 0.9	17.2 ± 0.9	16.2 ± 6.8
Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.						
8th International Intercomparison						
115-8C	$CaSO_4$: Dy Cards	Jan, 1986	Field, Site 1	32.2 ± 0.7	29.7 ± 1.5	28.9 ± 12.4

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

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
115-8C	$CaSO_4$: Dy Cards	Jan, 1986	Field, Site 2	10.6 ± 0.6	10.4 ± 0.5	10.1 ± 9.0
115-8C	$CaSO_4$: Dy Cards	Jan, 1986	Lab, Cs-137	18.1 ± 0.8	17.2 ± 0.9	16.2 ± 6.8

Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.

9th International Intercomparison

115-9

The Ninth International Intercomparison of Environmental Dosimeters was not available to Teledyne's Midwest Laboratory.

10th International Intercomparison

115-10A	LiF-100 Chips	Aug, 1993	Field	25.7 ± 1.4	27.0 ± 1.6	26.4 ± 10.2
115-10A	LiF-100 Chips	Aug, 1993	Lab, 1	22.7 ± 1.6	25.9 ± 1.3	25.0 ± 9.4
115-10A	LiF-100 Chips	Aug, 1993	Lab, 2	62.7 ± 2.6	72.7 ± 1.9	69.8 ± 20.3

The Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho State University and sponsored by the U.S. Department of Energy and the Idaho State University.

10th International Intercomparison

115-10B	$CaSO_4$: Dy Cards	Aug, 1993	Field	26.0 ± 2.3	27.0 ± 1.6	26.4 ± 10.2
115-10B	$CaSO_4$: Dy Cards	Aug, 1993	Lab, 1	24.1 ± 1.7	25.9 ± 1.3	25.0 ± 9.4
115-10B	$CaSO_4$: Dy Cards	Aug, 1993	Lab, 2	69.2 ± 3.0	72.7 ± 1.9	69.8 ± 20.3

The Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho Stat University and sponsored by the U.S. Department of Energy and the Idaho Stat University.

Teledyne Testing

89-1	LiF-100 Chips	Sep, 1989	Lab	21.0 ± 0.4	22.4	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in September, 1989.

Teledyne Testing

89-2	Teledyne $CaSo_4$: Dy Cards	Nov, 1989	Lab	20.9 ± 1.0	20.3	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in June, 1990.

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

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
Teledyne Testing						
90-1	Teledyne $CaSo_4$: Dy Cards	Jun, 1990	Lab	20.6 ± 1.4	19.6	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in June, 1990.						
Teledyne Testing						
90-2	Teledyne $CaSo_4$: Dy Cards	Jun, 1990	Lab	100.8 ± 4.3	100.0	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Dosimetry Asssociates, Inc., Northville, MI, in October, 1990.						
Teledyne Testing						
91-1	Teledyne $CaSo_4$: Dy Cards	Oct, 1990	Lab, 1	33.4 ± 2.0	32.0	ND
91-1	Teledyne $CaSo_4$: Dy Cards	Oct, 1990	Lab, 2	55.2 ± 4.7	58.8	ND
91-1	Teledyne $CaSo_4$: Dy Cards	Oct, 1990	Lab, 3	87.8 ± 6.2	85.5	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in October, 1991.						
Teledyne Testing						
92-1	LiF-100 Chips	Feb, 1992	Lab, 1	11.1 ± 0.2	10.7	ND
92-1	LiF-100 Chips	Feb, 1992	Lab, 2	25.6 ± 0.5	25.4	ND
92-1	LiF-100 Chips	Feb, 1992	Lab, 3	46.4 ± 0.5	46.3	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in February, 1992.						
Teledyne Testing						
92-2	Teledyne $CaSo_4$: Dy Cards	Apr, 1992	Reader 1, #1	20.1 ± 0.1	20.1	ND
92-2	Teledyne $CaSo_4$: Dy Cards	Apr, 1992	Reader 1, #2	40.6 ± 0.1	40.0	ND

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

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
92-2	Teledyne $CaSo_4$: Dy Cards	Apr, 1992	Reader 1, #3	60.0 ± 1.3	60.3	ND
92-2	Teledyne $CaSo_4$: Dy Cards	Apr, 1992	Reader 2, #1	20.3 ± 0.3	20.1	ND
92-2	Teledyne $CaSo_4$: Dy Cards	Apr, 1992	Reader 2, #2	39.2 ± 0.3	40.0	ND
92-2	Teledyne $CaSo_4$: Dy Cards	Apr, 1992	Reader 2, #3	60.7 ± 0.4	60.3	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in April, 1992.

Teledyne Testing

93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab, 1	10.0 ± 1.0	10.2	ND
93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab, 2	25.2 ± 2.2	25.5	ND
93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab, 3	42.7 ± 5.7	45.9	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in March, 1993. Due to a potential error of 10-12% when cards where irradiated, results of the testing on the cards will not be published. Data is available upon request.

Teledyne Testing

94-1	Teledyne LiF-100 Chips	Nov, 1994	Lab, 1	15.6 ± 0.4	14.9	ND
94-1	Teledyne LiF-100 Chips	Nov, 1994	Lab, 2	30.2 ± 0.4	29.8	ND
94-1	Teledyne LiF-100 Chips	Nov, 1994	Lab, 3	59.2 ± 0.3	59.7	ND
94-1	Teledyne $CaSo_4$: Dy Cards	Nov, 1994	Reader 1, #1	14.9 ± 0.1	14.9	ND
94-1	Teledyne $CaSo_4$: Dy Cards	Nov, 1994	Reader 1, #2	30.8 ± 0.1	29.8	ND

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

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
94-1	Teledyne $CaSo_4$: Dy Cards	Nov, 1994	Reader 1, #3	58.9 ± 0.3	59.7	ND
94-1	Teledyne $CaSo_4$: Dy Cards	Nov, 1994	Reader 2, #1	15.4 ± 0.2	14.9	ND
94-1	Teledyne $CaSo_4$: Dy Cards	Nov, 1994	Reader 2, #2	31.4 ± 0.2	29.8	ND
94-1	Teledyne $CaSo_4$: Dy Cards	Nov, 1994	Reader 2, #3	60.1 ± 0.3	59.7	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.
Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in November, 1994.

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-7569	WATER	Jul, 1995	H-3	25806.9 ± 447.7	26669.0	21335.2 - 32002.8
SPAP-10967	AIR FILTER	Nov, 1995	Gr. Beta	7.3 ± 0.0	8.0	0.0 - 18.0
SPAP-2513	AIR FILTER	Apr, 1995	Gr. Beta	7.5 ± 0.0	8.1	0.0 - 18.1
SPAP-2542	AIR FILTER	Apr, 1995	Cs-137	2.3 ± 2.1	1.9	1.2 - 2.7
SPAP-284	AIR FILTER	Jan, 1995	Cs-137	2.2 ± 0.0	1.9	1.2 - 2.7
SPAP-284	AIR FILTER	Jan, 1995	I-131(g)	2.2 ± 0.0	1.9	1.2 - 2.7
SPAP-408	AIR FILTER	Jan, 1995	Gr. Beta	7.5 ± 0.0	8.1	0.0 - 18.1
SPAP-7554	AIR FILTER	Jul, 1995	Gr. Beta	7.3 ± 0.0	8.1	0.0 - 18.1
SPAP-7557	AIR FILTER	Jul, 1995	Cs-137	2.3 ± 0.0	1.9	1.2 - 2.7
SPCH-11238	CHARCOAL CANISTER	Oct, 1995	I-131(g)	0.8 ± 0.0	0.8	0.5 - 1.1
SPCH-5964	CHARCOAL CANISTER	Jun, 1995	I-131(g)	2.2 ± 0.1	2.3	1.4 - 3.3
SPCH-717	CHARCOAL CANISTER	Jan, 1995	I-131(g)	2.9 ± 0.1	2.5	1.5 - 3.4
SPF-10921	FISH	Oct, 1995	Co-60	0.7 ± 0.0	0.8	0.5 - 1.1
SPF-10921	FISH	Oct, 1995	Cs-134	0.5 ± 0.0	0.6	0.3 - 0.8
SPF-10921	FISH	Oct, 1995	Cs-137	0.9 ± 0.1	0.9	0.5 - 1.2
SPF-3708	FISH	May, 1995	Cs-134	0.1 ± 0.0	0.1	0.1 - 0.2
SPF-3708	FISH	May, 1995	Cs-137	0.2 ± 0.0	0.2	0.1 - 0.2
SPMI-205	MILK	Jan, 1995	Cs-137	51.2 ± 7.5	49.4	39.4 - 59.4
SPMI-205	MILK	Jan, 1995	Sr-89	19.4 ± 3.4	23.1	13.1 - 33.1
SPMI-205	MILK	Jan, 1995	Sr-90	26.2 ± 1.3	28.1	18.1 - 38.1
SPMI-2988	MILK	Apr, 1995	Cs-134	37.0 ± 1.8	40.7	30.7 - 50.7
SPMI-2988	MILK	Apr, 1995	Cs-137	62.4 ± 3.1	54.5	44.5 - 64.5
SPMI-2988	MILK	Apr, 1995	Sr-89	32.6 ± 3.3	36.5	26.5 - 46.5
SPMI-2988	MILK	Apr, 1995	Sr-90	25.6 ± 1.6	24.9	14.9 - 34.9
SPMI-6838	MILK	Jun, 1995	I-131	38.5 ± 0.5	39.6	27.6 - 51.6
SPMI-707	MILK	Jan, 1995	I-131	80.3 ± 1.4	86.0	68.8 - 103.2
SPMI-707	MILK	Jan, 1995	I-131(g)	84.8 ± 10.4	86.0	51.6 - 96.0
SPMI-7525	MILK	Jul, 1995	Cs-134	31.5 ± 2.5	34.4	24.4 - 44.4
SPMI-7525	MILK	Jul, 1995	Cs-137	50.2 ± 4.0	43.4	33.4 - 53.4
SPMI-7525	MILK	Jul, 1995	I-131(g)	44.7 ± 5.4	45.6	27.4 - 55.6
SPMI-7525	MILK	Jul, 1995	Sr-90	28.0 ± 1.4	27.9	17.9 - 37.9
SPSO-5130	SOIL	May, 1995	Cs-134	0.3 ± 0.0	0.3	0.2 - 0.4
SPSO-5130	SOIL	May, 1995	Cs-137	0.5 ± 0.0	0.5	0.3 - 0.7

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
SPVE-6006	VEGETATION	Jun, 1995	I-131(g)	0.6 ± 0.0	0.5	0.3 - 0.8
SPVE-7190	VEGETATION	Jul, 1995	I-131(g)	1.1 ± 0.0	1.0	0.6 - 1.4
SPVE-729	VEGETATION	Feb, 1995	I-131(g)	1.9 ± 0.1	1.9	1.1 - 2.6
SPW-1204	WATER	Feb, 1995	Ra-226	6.9 ± 0.1	6.9	4.8 - 9.0
SPW-12079	WATER	Nov, 1995	H-3	27963.4 ± 445.5	29315.0	23452.0 - 35178.0
SPW-12084	WATER	Nov, 1995	Gr. Alpha	75.3 ± 3.2	82.8	41.4 - 124.2
SPW-12084	WATER	Nov, 1995	Gr. Beta	86.9 ± 2.5	86.3	76.3 - 96.3
SPW-1790	WATER	Mar, 1995	Sr-89	0.9 ± 3.9	42.7	32.7 - 52.7
The raw data was reviewed and found to be free of errors. The sample was repeated with similar results.An Investigation was conducted to determine the cause of this deviation. No apparent cause was found for this discrepancy. It was determined the "spike" was prepared improperly. Another "spike" was prepared and analyzed (See SPW-6388). No further action is planned.						
SPW-1790	WATER	Mar, 1995	Sr-90	31.4 ± 1.8	39.1	31.3 - 46.9
The raw data was reviewed and found to be free of errors. The sample was repeated with similar results.An Investigation was conducted to determine the cause of this deviation. No apparent cause was found for this discrepancy. It was determined the "spike" was prepared improperly. Another "spike" was prepared and analyzed (See SPW-6388). No further action is planned.						
SPW-2544	WATER	Apr, 1995	H-3	9656.2 ± 291.8	9333.0	7466.4 - 11199.6
SPW-2652	WATER	Apr, 1995	Co-60	23.8 ± 2.4	24.8	14.8 - 34.8
SPW-2652	WATER	Apr, 1995	Cs-134	29.3 ± 2.3	30.8	20.8 - 40.8
SPW-2652	WATER	Apr, 1995	Cs-137	42.3 ± 3.9	40.9	30.9 - 50.9
SPW-286	WATER	Jan, 1995	H-3	40929.9 ± 5594.5	40871.0	32696.8 - 49045.2
SPW-289	WATER	Jan, 1995	Co-60	250.5 ± 14.1	247.5	222.8 - 272.3
SPW-289	WATER	Jan, 1995	Cs-134	290.5 ± 14.4	321.3	289.2 - 353.4
SPW-289	WATER	Jan, 1995	Cs-137	387.7 ± 21.2	394.3	354.9 - 433.7
SPW-3051	WATER	Mar, 1995	Gr. Alpha	88.5 ± 3.7	82.9	41.5 - 124.4
SPW-3051	WATER	Apr, 1995	Gr. Alpha	88.0 ± 3.8	82.9	41.5 - 124.4
SPW-3051	WATER	Mar, 1995	Gr. Beta	83.0 ± 2.3	87.2	77.2 - 97.2
SPW-3051	WATER	Apr, 1995	Gr. Beta	79.6 ± 2.3	87.2	77.2 - 97.2
SPW-3589	WATER	May, 1995	Fe-55	2033.7 ± 500.2	2274.0	1819.2 - 2728.8
SPW-5608	WATER	Jun, 1995	I-131	78.8 ± 2.3	85.5	68.4 - 102.6
SPW-6005	WATER	Jun, 1995	I-131	48.2 ± 1.9	46.8	34.8 - 58.8
SPW-6008	WATER	May, 1995	Gr. Alpha	17.3 ± 1.4	20.7	10.4 - 31.1
SPW-6008	WATER	May, 1995	Gr. Beta	21.2 ± 1.0	21.8	11.8 - 31.8
SPW-6388	WATER	May, 1995	Sr-89	18.7 ± 2.4	21.2	11.2 - 31.2
SPW-6388	WATER	May, 1995	Sr-90	21.2 ± 1.1	23.2	13.2 - 33.2

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-6398	WATER	May, 1995	Sr-89	18.7 ± 2.4	21.2	11.2 - 31.2
SPW-6398	WATER	May, 1995	Sr-90	21.2 ± 1.1	23.2	13.2 - 33.2
SPW-6839	WATER	Jun, 1995	I-131	34.9 ± 0.5	39.5	27.5 - 51.5
SPW-8179	WATER	Jul, 1995	Fe-55	2.3 ± 0.4	2.1	0.0 - 22.1
SPW-9981	WATER	Sep, 1995	Sr-89	34.6 ± 4.9	39.0	29.0 - 49.0
SPW-9981	WATER	Sep, 1995	Sr-90	20.3 ± 1.3	20.0	10.0 - 30.0

[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)
SPAP-10968	AIR FILTER	Nov 1995	Gr. Beta	<0.4	0.61 ± 0.26	< 3.2
SPAP-2514	AIR FILTER	Apr 1995	Gr. Beta	<0.3	0.03 ± 0.25	< 3.2
SPAP-2543	AIR FILTER	Apr 1995	Co-60	<4.4	0.39 ± 2.20	< 10.0
SPAP-2543	AIR FILTER	Apr 1995	Cs-134	<1.9	0.05 ± 2.11	< 10.0
SPAP-2543	AIR FILTER	Apr 1995	Cs-137	<1.1	-1.24 ± 1.83	< 10.0
SPAP-283	AIR FILTER	Jan 1995	Co-60	<2.7	-0.36 ± 1.40	< 10.0
SPAP-283	AIR FILTER	Jan 1995	Cs-134	<1.5	-0.67 ± 1.33	< 10.0
SPAP-283	AIR FILTER	Jan 1995	Cs-137	<2.4	0.46 ± 1.33	< 10.0
SPAP-409	AIR FILTER	Jan 1995	Gr. Beta	<0.5	0.02 ± 0.28	< 3.2
SPAP-7556	AIR FILTER	Jul 1995	Gr. Beta	<1.0	0.06 ± 0.55	< 3.2
SPAP-7558	AIR FILTER	Jul 1995	Co-60	<4.2	0.39 ± 3.06	< 10.0
SPAP-7558	AIR FILTER	Jul 1995	Co-60	<4.2	0.04 ± 3.07	< 10.0
SPAP-7558	AIR FILTER	Jul 1995	Cs-134	<3.0	-1.23 ± 2.45	< 10.0
SPAP-7558	AIR FILTER	Jul 1995	Cs-137	<3.5	1.18 ± 2.04	< 10.0
SPCH-11238	CHARCOAL CANISTER	Oct 1995	I-131(g)	<1.9	-0.00 ± 0.01	< 9.6
SPCH-287	CHARCOAL CANISTER	Jan 1995	I-131(g)	<2.3	-1.98 ± 3.12	< 9.6
SPCH-5975	CHARCOAL CANISTER	Jun 1995	I-131(g)	<3.0	-0.71 ± 2.68	< 9.6
SPF-10922	FISH	Oct 1995	Co-60	<5.4	5.74 ± 4.70	< 10.0
SPF-10922	FISH	Oct 1995	Cs-134	<8.9	2.47 ± 5.44	< 10.0
SPF-10922	FISH	Oct 1995	Cs-137	<5.4	-2.44 ± 5.08	< 10.0
SPF-3709	FISH	May 1995	Co-60	<8.4	2.21 ± 5.97	< 10.0
SPF-3709	FISH	May 1995	Cs-134	<1.3	6.79 ± 8.55	< 10.0
SPF-3709	FISH	May 1995	Cs-137	<1.3	3.61 ± 7.81	< 10.0
SPM-204	MILK	Jan 1995	Co-60	<5.3	0.41 ± 3.48	< 10.0
SPM-204	MILK	Jan 1995	Cs-134	<4.4	-0.07 ± 2.05	< 10.0
SPM-204	MILK	Jan 1995	Cs-137	<4.3	1.32 ± 2.53	< 10.0
SPM-204	MILK	Jan 1995	I-131	<0.5	-0.03 ± 0.22	< 0.5
SPM-204	MILK	Jan 1995	Sr-89	<0.8	0.14 ± 1.08	< 5.0
SPM-204	MILK	Jan 1995	Sr-90	N/A	1.46 ± 0.48	< 1.0
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPMI-10920	MILK	Oct 1995	Co-60	<3.8	-0.45 ± 5.05	< 10.0
SPMI-10920	MILK	Oct 1995	Cs-134	<3.5	-2.79 ± 4.35	< 10.0

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)
SPMI-10920	MILK	Oct 1995	Cs-137	<6.0	1.55 ± 4.13	< 10.0
SPMI-2987	MILK	Apr 1995	Cs-134	<3.4	0.37 ± 1.89	< 10.0
SPMI-2987	MILK	Apr 1995	Cs-137	<3.3	1.29 ± 1.75	< 10.0
SPMI-2987	MILK	Apr 1995	Sr-89	<0.4	0.06 ± 0.62	< 5.0
SPMI-2987	MILK	Apr 1995	Sr-90	N/A	1.47 ± 0.38	< 1.0
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPMI-7526	MILK	Jul 1995	Co-60	<5.8	1.19 ± 3.34	< 10.0
SPMI-7526	MILK	Jul 1995	Cs-134	<5.1	0.48 ± 2.76	< 10.0
SPMI-7526	MILK	Jul 1995	Cs-137	<3.7	0.98 ± 2.39	< 10.0
SPMI-7526	MILK	Jul 1995	I-131	<0.5	0.00 ± 0.23	< 0.5
SPMI-7526	MILK	Jul 1995	Sr-89	<0.6	-0.19 ± 0.82	< 5.0
SPMI-7526	MILK	Jul 1995	Sr-90	N/A	1.35 ± 0.36	< 1.0
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPSO-11225	SOIL	Oct 1995	Cs-134	<0.034	0.00 ± 0.02	< 10.0
SPSO-11225	SOIL	Oct 1995	Cs-137	<0.019	-0.00 ± 0.01	< 10.0
SPSO-5131	SOIL	May 1995	Cs-134	<0.034	0.01 ± 0.01	< 10.0
SPSO-5131	SOIL	May 1995	Cs-137	<0.012	0.00 ± 0.01	< 10.0
SPVE-6007	VEGETATION	Jun 1995	I-131(g)	<0.009	0.00 ± 0.01	< 20.0
SPVE-7191	VEGETATION	Jul 1995	I-131(g)	<0.005	-0.00 ± 0.00	< 20.0
SPVE-728	VEGETATION	Jan 1995	I-131(g)	<12.0	2.33 ± 7.54	< 20.0
SPW-1106	WATER	Feb 1995	Ni-63	<12.0	0.25 ± 6.31	< 20.0
SPW-12080	WATER	Nov 1995	H-3	<149	23.01 ± 74.94	< 200.0
SPW-12082	WATER	Nov 1995	Co-60	<2.1	0.62 ± 1.13	< 10.0
SPW-12082	WATER	Nov 1995	Cs-134	<1.9	0.02 ± 1.28	< 10.0
SPW-12082	WATER	Nov 1995	Cs-137	<2.4	1.53 ± 1.22	< 10.0
SPW-12082	WATER	Nov 1995	Gr. Alpha	<0.6	0.19 ± 0.43	< 1.0
SPW-12082	WATER	Nov 1995	Gr. Beta	<1.7	0.06 ± 1.11	< 3.2
SPW-2545	WATER	Apr 1995	H-3	<169	97.76 ± 88.37	< 200.0
SPW-2651	WATER	Apr 1995	Co-60	<3.17	-1.08 ± 2.45	< 10.0
SPW-2651	WATER	Apr 1995	Cs-134	<3.32	0.29 ± 2.57	< 10.0
SPW-2651	WATER	Apr 1995	Cs-137	<3.56	-0.92 ± 2.64	< 10.0
SPW-285	WATER	Jan 1995	H-3	<165.0	-48.53 ± 84.76	< 200.0
SPW-288	WATER	Jan 1995	Co-60	<2.3	-0.11 ± 2.02	< 10.0
SPW-288	WATER	Jan 1995	Cs-134	<3.5	-0.19 ± 2.61	< 10.0

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 (± 66 Sigma)
SPW-288	WATER	Jan 1995	Cs-137	<4.7	0.98 ± 2.54	< 10.0
SPW-3052	WATER	Mar 1995	Gr. Alpha	<0.6	0.49 ± 0.43	< 1.0
SPW-3052	WATER	Apr 1995	Gr. Alpha	<0.7	0.23 ± 0.47	< 1.0
SPW-3052	WATER	Mar 1995	Gr. Beta	<1.4	3.05 ± 0.98	< 3.2
SPW-3052	WATER	Apr 1995	Gr. Beta	<1.7	-0.02 ± 1.09	< 3.2
SPW-3590	WATER	May 1995	Fe-55	<602.0	0.00 ± 365.40	< 1000.0
SPW-6011	WATER	Jun 1995	I-131	<0.4	-0.03 ± 0.19	< 0.5
SPW-7570	WATER	Jul 1995	H-3	<164	51.58 ± 83.71	< 200.0
SPW-8180	WATER	Jul 1995	Fe-55	<0.4	0.00 ± 0.27	< 1000.0
SPW-8931	WATER	Aug 1995	Ra-228	<1.0	0.58 ± 0.61	< 1.0
SPW-957	WATER	Feb 1995	Co-60	<3.7	-1.25 ± 3.02	< 10.0
SPW-957	WATER	Feb 1995	Cs-134	<5.2	0.76 ± 2.77	< 10.0
SPW-957	WATER	Feb 1995	Cs-137	<3.6	-1.38 ± 2.65	< 10.0
SPW-9982	WATER	Sep 1995	Sr-89	<0.8	0.52 ± 0.76	< 5.0
SPW-9982	WATER	Sep 1995	Sr-90	<0.4	0.21 ± 0.21	< 1.0

[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[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
WW-62, 63	Jan, 1995	Gr. Beta	1.4160 ± 0.4220	1.2900 ± 0.4000	1.3530 ± 0.2907
WW-62, 63	Jan, 1995	H-3	22.5635 ± 80.8891	18.8029 ± 80.7140	20.6832 ± 57.1354
WW-41, 42	Jan, 1995	Gr. Alpha	5.0970 ± 2.5260	2.4790 ± 2.1920	3.7880 ± 1.6722
WW-41, 42	Jan, 1995	Gr. Beta	4.6720 ± 0.8260	4.9650 ± 0.8770	4.8185 ± 0.6024
WW-41, 42	Jan, 1995	H-3	30.0800 ± 81.2250	-47.0000 ± 77.7750	-8.4600 ± 56.2282
WW-41, 42	Jan, 1995	K-40	1.3840 ± 0.2076	1.7300 ± 0.2595	1.5570 ± 0.1662
WW-41, 42	Jan, 1995	Sr-89	-0.3474 ± 0.5730	-0.0685 ± 0.5382	-0.2079 ± 0.3931
WW-41, 42	Jan, 1995	Sr-90	0.2017 ± 0.2519	0.1389 ± 0.2174	0.1703 ± 0.1664
CF-20, 21	Jan, 1995	Be-7	0.4327 ± 0.1200	0.4741 ± 0.1250	0.4534 ± 0.0866
CF-20, 21	Jan, 1995	Gr. Beta	2.9120 ± 0.0930	2.9920 ± 0.0920	2.9520 ± 0.0654
CF-20, 21	Jan, 1995	K-40	4.0808 ± 0.3060	3.7714 ± 0.3050	3.9261 ± 0.2160
CF-20, 21	Jan, 1995	Sr-89	0.0013 ± 0.0043	0.0000 ± 0.0058	0.0007 ± 0.0036
CF-20, 21	Jan, 1995	Sr-90	0.0017 ± 0.0011	0.0026 ± 0.0015	0.0021 ± 0.0009
CW-105, 106	Jan, 1995	Gr. Beta	5.4370 ± 0.9970	6.1900 ± 1.0260	5.8135 ± 0.7153
CW-105, 106	Jan, 1995	Gr. Beta	0.0490 ± 0.4360	0.0590 ± 0.4360	0.0540 ± 0.3083
MI-83, 84	Jan, 1995	Co-60	-0.3330 ± 2.5300	0.6530 ± 2.1700	0.1600 ± 1.6666
MI-83, 84	Jan, 1995	Cs-137	-1.1400 ± 2.2700	0.0761 ± 1.8700	-0.5320 ± 1.4705
MI-83, 84	Jan, 1995	I-131(G)	-1.9100 ± 3.2000	1.4700 ± 2.4700	-0.2200 ± 2.0212
MI-187, 188	Jan, 1995	I-131	0.1496 ± 0.2574	0.2682 ± 0.3828	0.2089 ± 0.2306
MI-187, 188	Jan, 1995	K-40	1,573.0000 ± 138.0000	1,426.0000 ± 177.0000	1,499.5000 ± 112.2197
SW-213, 214	Jan, 1995	H-3	5,939.6340 ± 241.2390	6,091.2412 ± 232.8063	6,015.4376 ± 167.6269
WW-240, 241	Jan, 1995	H-3	39.8030 ± 80.3410	9.9510 ± 78.9420	24.8770 ± 56.3172
WW-316, 317	Jan, 1995	H-3	17,618.0000 ± 377.0000	17,390.0000 ± 381.0000	17,504.0000 ± 267.9972
MI-295, 296	Jan, 1995	Co-60	-1.0900 ± 2.3700	0.2510 ± 2.8000	-0.4195 ± 1.8342
MI-295, 296	Jan, 1995	Cs-134	-0.6360 ± 1.8100	0.7830 ± 2.4400	0.0735 ± 1.5190
MI-295, 296	Jan, 1995	Cs-137	0.5200 ± 1.8200	1.2900 ± 2.6800	0.9050 ± 1.6198
MI-295, 296	Jan, 1995	I-131	0.1300 ± 0.2600	0.2300 ± 0.3400	0.1800 ± 0.2140
MI-295, 296	Jan, 1995	I-131(g)	-0.3970 ± 2.3600	-0.0386 ± 4.3000	-0.2178 ± 2.4525
MI-295, 296	Jan, 1995	K-40	1,449.1000 ± 91.2000	1,311.8000 ± 108.0000	1,380.4500 ± 70.6779
MI-295, 296	Jan, 1995	La-140	0.6220 ± 1.6900	-1.1800 ± 2.5000	-0.2790 ± 1.5088
MI-295, 296	Jan, 1995	Sr-89	0.2267 ± 0.7985	0.1552 ± 0.9326	0.1909 ± 0.6139
MI-295, 296	Jan, 1995	Sr-90	1.3813 ± 0.3839	1.6174 ± 0.4296	1.4993 ± 0.2881
LW-609, 610	Jan, 1995	Gr. Beta	2.6380 ± 0.7310	1.6940 ± 0.6930	2.1660 ± 0.5036
LW-344, 345	Jan, 1995	Co-60	-0.1680 ± 1.8700	1.5200 ± 3.1100	0.6760 ± 1.8145
LW-344, 345	Jan, 1995	Cs-137	0.3820 ± 1.9200	-0.1570 ± 2.9500	0.1125 ± 1.7599
LW-344, 345	Jan, 1995	Gr. Beta	3.2810 ± 0.9440	3.3500 ± 0.9390	3.3155 ± 0.6657

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-374, 375	Jan, 1995	I-131	-0.0572 ± 0.2162	-0.0743 ± 0.2780	-0.0658 ± 0.1761
MI-374, 375	Jan, 1995	K-40	1,250.0000 ± 150.0000	1,286.5000 ± 141.0000	1,268.2500 ± 102.9332
SW-463, 464	Jan, 1995	Gr. Beta	1.8970 ± 0.5970	1.9470 ± 0.6020	1.9220 ± 0.4239
SW-463, 464	Jan, 1995	H-3	35.5580 ± 80.3070	7.4860 ± 78.9880	21.5220 ± 56.3212
WWU-860, 861	Jan, 1995	Gr. Alpha	0.3000 ± 0.6000	0.2000 ± 0.3000	0.2500 ± 0.3354
WWU-860, 861	Jan, 1995	Gr. Beta	0.8450 ± 1.3200	1.7600 ± 1.3500	1.3025 ± 0.9440
WWU-860, 861	Jan, 1995	K-40	61.8050 ± 32.9000	70.9860 ± 36.2000	66.3955 ± 24.4584
SW-586, 587	Jan, 1995	Co-60	-2.1600 ± 2.2900	1.9400 ± 2.7500	-0.1100 ± 1.7893
SW-586, 587	Jan, 1995	Cs-137	0.5590 ± 2.3400	1.5000 ± 2.8800	1.0295 ± 1.8554
WW-547, 548	Jan, 1995	H-3	602.5630 ± 102.9290	619.5980 ± 103.5540	611.0805 ± 73.0031
SWT-715, 716	Jan, 1995	Gr. Beta	2.3000 ± 0.6000	2.3000 ± 0.5000	2.3000 ± 0.3905
SW-694, 695	Feb, 1995	Gr. Beta	3.9100 ± 0.7450	4.1790 ± 0.7550	4.0445 ± 0.5303
WW-736, 737	Feb, 1995	H-3	9,951.8722 ± 284.2655	10,200.7626 ± 287.5238	10,076.3174 ± 202.1613
WW-763, 764	Feb, 1995	H-3	584.4290 ± 101.0550	707.1020 ± 105.5380	645.7655 ± 73.0589
MI-881, 882	Feb, 1995	I-131	0.1760 ± 0.2567	0.1552 ± 0.2852	0.1656 ± 0.1919
MI-881, 882	Feb, 1995	K-40	1,340.4000 ± 164.0000	1,492.0000 ± 101.0000	1,416.2000 ± 96.302[c]
MI-838, 839	Feb, 1995	Co-60	0.9670 ± 2.6500	-0.4760 ± 3.8100	0.2455 ± 2.3205
MI-838, 839	Feb, 1995	Cs-134	-0.0557 ± 2.2800	-1.4200 ± 3.0900	-0.7379 ± 1.9201
MI-838, 839	Feb, 1995	Cs-137	-0.4380 ± 2.5500	-0.4370 ± 3.0900	-0.4375 ± 2.0032
MI-838, 839	Feb, 1995	I-131	0.1283 ± 0.1951	0.0880 ± 0.1984	0.1081 ± 0.1391
MI-838, 839	Feb, 1995	I-131(g)	-0.2560 ± 2.5800	-0.5630 ± 3.1800	-0.4095 ± 2.0475
MI-838, 839	Feb, 1995	K-40	1,298.6000 ± 99.4000	1,232.5000 ± 125.0000	1,265.5500 ± 79.8520
MI-838, 839	Feb, 1995	Sr-89	0.5302 ± 0.5774	0.5000 ± 0.6000	0.5151 ± 0.4164
MI-838, 839	Feb, 1995	Sr-90	0.8186 ± 0.2809	0.8000 ± 0.3000	0.8093 ± 0.2055
MI-937, 938	Feb, 1995	I-131	-0.0083 ± 0.1800	-0.0270 ± 0.1800	-0.0177 ± 0.1273
MI-937, 938	Feb, 1995	K-40	1,451.8000 ± 69.6000	1,456.6000 ± 141.0000	1,454.2000 ± 78.6212
SW-904, 905	Feb, 1995	H-3	640.3425 ± 104.5679	597.4040 ± 103.0233	618.8733 ± 73.3966
MI-1216, 1217	Feb, 1995	I-131	0.2640 ± 0.2740	0.1160 ± 0.2600	0.1900 ± 0.1889
MI-1216, 1217	Feb, 1995	K-40	1,583.0000 ± 131.0000	1,493.6000 ± 174.0000	1,538.3000 ± 108.9002
SW-1237, 1238	Feb, 1995	H-3	55.3942 ± 97.3964	4.8591 ± 95.3581	30.1267 ± 68.1528
SW-1264, 1265	Feb, 1995	H-3	67.0910 ± 81.1760	109.2630 ± 83.1440	88.1770 ± 58.1001
G-1343, 1344	Feb, 1995	Be-7	11.4490 ± 0.2850	11.8800 ± 0.2560	11.6645 ± 0.1915
G-1343, 1344	Feb, 1995	K-40	2.9844 ± 0.2420	3.0269 ± 0.2250	3.0057 ± 0.1652
SW-1494, 1495	Feb, 1995	Co-60	-2.1900 ± 4.1200	0.0565 ± 3.4400	-1.0668 ± 2.6837
SW-1494, 1495	Feb, 1995	Cs-137	3.4500 ± 3.6600	0.2430 ± 3.5700	1.8465 ± 2.5564
SW-1367, 1368	Feb, 1995	H-3	560.3183 ± 103.1109	606.1104 ± 104.7919	583.2144 ± 73.5072

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
WW-1394, 1395	Feb, 1995	H-3	47.8810 ± 80.1790	-24.8930 ± 76.6250	11.4940 ± 55.4528
SWT-1515, 1516	Feb, 1995	Gr. Beta	2.4460 ± 0.5250	1.6920 ± 0.5000	2.0690 ± 0.3625
WW-1536, 1537	Feb, 1995	H-3	2,874.3025 ± 167.5000	2,924.0574 ± 168.6330	2,899.1800 ± 118.8416
WW-1563, 1564	Mar, 1995	H-3	33.5160 ± 82.6640	39.5490 ± 82.9570	36.5325 ± 58.5560
WW-1618, 1619	Mar, 1995	Co-60	2.8000 ± 1.5000	2.2000 ± 4.6000	2.5000 ± 2.4192
WW-1618, 1619	Mar, 1995	Cs-137	-0.9000 ± 1.7000	-2.5000 ± 3.2000	-1.7000 ± 1.8118
WW-1618, 1619	Mar, 1995	H-3	4,333.0000 ± 204.0000	4,457.0000 ± 206.0000	4,395.0000 ± 144.9586
MI-1663, 1664	Mar, 1995	Co-60	1.9500 ± 3.2400	-1.5300 ± 2.7200	0.2100 ± 2.1152
MI-1663, 1664	Mar, 1995	Cs-134	0.1690 ± 2.7700	-1.1300 ± 2.0500	-0.4805 ± 1.7230
MI-1663, 1664	Mar, 1995	Cs-137	-0.0737 ± 2.7400	0.9210 ± 2.4100	0.4237 ± 1.8245
MI-1663, 1664	Mar, 1995	I-131	0.1226 ± 0.2720	0.2261 ± 0.3010	0.1744 ± 0.2028
MI-1663, 1664	Mar, 1995	I-131(g)	-0.4090 ± 3.7100	0.1220 ± 3.4200	-0.1435 ± 2.5229
MI-1663, 1664	Mar, 1995	K-40	1,592.1000 ± 124.0000	1,555.6000 ± 118.0000	1,573.8500 ± 85.5862
MI-1663, 1664	Mar, 1995	La-140	-1.6500 ± 3.1000	-0.2240 ± 2.6800	-0.9370 ± 2.0489
MI-1663, 1664	Mar, 1995	Sr-89	0.5984 ± 0.6672	0.5889 ± 0.7467	0.5937 ± 0.5007
MI-1663, 1664	Mar, 1995	Sr-90	1.3624 ± 0.3718	1.5034 ± 0.4517	1.4329 ± 0.2925
WW-1684, 1685	Mar, 1995	Gr. Beta	4.9280 ± 0.7420	5.0100 ± 0.7400	4.9690 ± 0.5240
WW-1684, 1685	Mar, 1995	H-3	81.7160 ± 84.9140	85.7340 ± 85.1040	83.7250 ± 60.1105
LW-1707, 1708	Mar, 1995	Co-58	0.4070 ± 3.0300	0.0486 ± 2.8500	0.2278 ± 2.0799
LW-1707, 1708	Mar, 1995	Co-60	1.0600 ± 2.8900	1.5000 ± 2.7000	1.2800 ± 1.9775
LW-1707, 1708	Mar, 1995	Cs-134	-1.8600 ± 3.0500	-1.5400 ± 2.8300	-1.7000 ± 2.0803
LW-1707, 1708	Mar, 1995	Cs-137	2.5900 ± 2.9600	-1.3700 ± 2.5100	0.6100 ± 1.9405
LW-1707, 1708	Mar, 1995	Fe-59	5.5200 ± 6.1500	-6.6900 ± 6.1500	-0.5850 ± 4.3487
LW-1707, 1708	Mar, 1995	Gr. Beta	1.9570 ± 0.4850	2.1270 ± 0.4760	2.0420 ± 0.3398
LW-1707, 1708	Mar, 1995	I-131	0.2350 ± 0 2925	-0.0500 ± 0.2859	0.0925 ± 0.2045
LW-1707, 1708	Mar, 1995	I-131(g)	-0.6900 ± 6.6800	-0.6210 ± 6.2000	-0.6555 ± 4.5569
LW-1707, 1708	Mar, 1995	K-40	79.3000 ± 42.8000	75.3000 ± 39.2000	77.3000 ± 29.0193
LW-1707, 1708	Mar, 1995	La-140	-3.5900 ± 5.0900	1.2800 ± 4.5800	-1.1550 ± 3.4236
LW-1707, 1708	Mar, 1995	Mn-54	-1.9300 ± 3 1200	0.7640 ± 2.5200	-0.5830 ± 2.0053
LW-1707, 1708	Mar, 1995	Ru-103	-0.1320 ± 3.3400	-0.7770 ± 2.9700	-0.4545 ± 2.2348
LW-1707, 1708	Mar, 1995	Zn-65	-2.6700 ± 6.4700	-1.7400 ± 5.7700	-2.2050 ± 4.3346
LW-1707, 1708	Mar, 1995	Zr-Nb-95	-0.2680 ± 3.0600	-3.2400 ± 2.7200	-1.7540 ± 2.0471
SW-1762, 1763	Mar, 1995	H-3	104.4150 ± 89.3960	92.2110 ± 88.8390	98.3130 ± 63.0159
SO-1861, 1862	Mar, 1995	Cs-137	0.2587 ± 0.0414	0.2481 ± 0.0248	0.2534 ± 0.0241
SO-1861, 1862	Mar, 1995	K-40	11.7290 ± 0.5530	11.2500 ± 0.4990	11.4895 ± 0.3724
SO-1861, 1862	Mar, 1995	Ra-226	1.6890 ± 0.3970	1.5274 ± 0.2730	1.6082 ± 0.2409

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SW-1919, 1920	Mar, 1995	H-3	-9.1230 ± 85.2000	66.6680 ± 88.8670	28.7725 ± 61.5556
SW-1919, 1920	Mar, 1995	H-3	-9.1230 ± 85.2005	66.6679 ± 88.8672	28.7725 ± 61.5559
WWU-2031, 2032	Mar, 1995	Gr. Alpha	1.9830 ± 2.2510	3.0330 ± 2.4400	2.5080 ± 1.6599
WWU-2031, 2032	Mar, 1995	Gr. Beta	1.2540 ± 1.9270	2.1120 ± 1.9680	1.6830 ± 1.3772
CW-1997, 1998	Mar, 1995	Gr. Beta	2.6670 ± 0.9880	2.3100 ± 1.3570	2.4885 ± 0.8393
CW-1997, 1998	Mar, 1995	Gr. Beta	-0.5301 ± 0.9521	0.6351 ± 1.1355	0.0525 ± 0.7409
AP-2784, 2785	Mar, 1995	Co-60	-0.0004 ± 0.0006	-0.0003 ± 0.0005	-0.0003 ± 0.0004
AP-2784, 2785	Mar, 1995	Cs-137	-0.0003 ± 0.0006	0.0001 ± 0.0004	-0.0001 ± 0.0004
MI-2083, 2084	Mar, 1995	I-131	0.0210 ± 0.1920	0.0150 ± 0.1850	0.0180 ± 0.1333
MI-2083, 2084	Mar, 1995	K-40	1,273.9000 ± 69.7000	1,328.9000 ± 59.8000	1,301.4000 ± 45.9188
MI-2083, 2084	Mar, 1995	Sr-90	1.5850 ± 0.4530	1.8040 ± 0.5520	1.6945 ± 0.3570
SW-2104, 2105	Mar, 1995	Gr. Beta	1.6690 ± 0.5320	1.7090 ± 0.5640	1.6890 ± 0.3877
SW-2200, 2201	Mar, 1995	H-3	33.7710 ± 85.6270	54.0340 ± 86.5810	43.9025 ± 60.8857
SW-2355, 2356	Mar, 1995	Co-60	0.6430 ± 1.5100	0.8670 ± 1.5800	0.7550 ± 1.0928
SW-2355, 2356	Mar, 1995	Cs-137	2.2000 ± 1.5400	0.0533 ± 1.8500	1.1267 ± 1.2035
AP-2453, 2454	Mar, 1995	Sr-89	0.0002 ± 0.0006	-0.0001 ± 0.0006	0.0000 ± 0.0004
AP-2453, 2454	Mar, 1995	Sr-90	0.0000 ± 0.0002	0.0001 ± 0.0003	0.0001 ± 0.0002
AP-2805, 2806	Mar, 1995	Co-60	-0.0001 ± 0.0004	0.0002 ± 0.0003	0.0000 ± 0.0002
AP-2805, 2806	Mar, 1995	Cs-137	0.0002 ± 0.0004	0.0000 ± 0.0004	0.0001 ± 0.0003
SW-2221, 2222	Mar, 1995	K-40	149.6900 ± 74.4000	119.3800 ± 46.7000	134.5350 ± 43.9211
PW-2248, 2249	Mar, 1995	H-3	154.6240 ± 91.0610	164.7520 ± 91.5110	159.6880 ± 64.5491
PW-2271, 2272	Mar, 1995	Co-60	-0.4760 ± 1.9800	-1.2100 ± 2.8900	-0.8430 ± 1.7516
PW-2271, 2272	Mar, 1995	Cs-137	0.9590 ± 2.0500	0.8750 ± 3.4600	0.9170 ± 2.0109
MI-2149, 2150	Apr, 1995	Co-60	-1.2100 ± 2.2200	0.6560 ± 2.6900	-0.2770 ± 1.7439
MI-2149, 2150	Apr, 1995	Cs-137	0.1650 ± 2.0400	2.3100 ± 2.2200	1.2375 ± 1.5075
MI-2149, 2150	Apr, 1995	I-131(G)	0.0888 ± 2.2200	0.3000 ± 2.5100	0.1944 ± 1.6754
WW-2313, 2314	Apr, 1995	Gr. Beta	0.5850 ± 0.4990	0.9810 ± 0.5230	0.7830 ± 0.3614
CW-2401, 2402	Apr, 1995	Gr. Beta	1.7069 ± 1.2973	3.4661 ± 1.4515	2.5865 ± 0.9734
CW-2401, 2402	Apr, 1995	Gr. Beta	0.0096 ± 1.1238	0.4760 ± 1.1031	0.2428 ± 0.7874
SL-2567, 2568	Apr, 1995	K-40	1.4123 ± 0.4360	1.7225 ± 0.3760	1.5674 ± 0.2879
WW-2432, 2433	Apr, 1995	H-3	-21.5803 ± 82.7489	2.6975 ± 83.9276	-9.4414 ± 58.9305
WW-2659, 2660	Apr, 1995	Gr. Beta	0.5450 ± 0.6040	0.3970 ± 0.4440	0.4710 ± 0.3748
WW-2659, 2660	Apr, 1995	H-3	38.3900 ± 87.4520	133.3540 ± 91.7350	85.8720 ± 63.3703
MI-2713, 2714	Apr, 1995	I-131	0.3870 ± 0.5277	0.1686 ± 0.2430	0.2778 ± 0.2905
MI-2713, 2714	Apr, 1995	K-40	1,420.9000 ± 137.0000	1,420.0000 ± 137.0000	1,420.4500 ± 96.8736
CW-2739, 2740	Apr, 1995	Gr. Beta	13.7987 ± 2.0770	14.3132 ± 2.1038	14.0560 ± 1.4782

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
CW-2739, 2740	Apr, 1995	Gr. Beta	5.0526 ± 1.5206	2.2742 ± 1.3431	3.6634 ± 1.0144
SW-2686, 2687	Apr, 1995	H-3	52.6753 ± 86.9675	2.0260 ± 84.5748	27.3506 ± 60.6552
WW-3447, 3448	Apr, 1995	Gr. Alpha	-0.2920 ± 1.6860	-1.4650 ± 1.6480	-0.8785 ± 1.1788
WW-3447, 3448	Apr, 1995	Gr. Beta	1.2340 ± 1.7000	3.1840 ± 1.8140	2.2090 ± 1.2430
CW-2835, 2836	Apr, 1995	Gr. Beta	1.9571 ± 1.4080	2.7378 ± 1.4641	2.3474 ± 1.0157
CW-2835, 2836	Apr, 1995	Gr. Beta	0.1817 ± 1.1916	0.8185 ± 1.2403	0.5001 ± 0.8600
CW-2918, 2919	Apr, 1995	Gr. Beta	5.3065 ± 1.6254	4.2821 ± 1.5611	4.7943 ± 1.1268
CW-2918, 2919	Apr, 1995	Gr. Beta	2.0988 ± 1.2349	0.7752 ± 1.2404	1.4370 ± 0.9111
F-3552, 3553	Apr, 1995	K-40	3.1142 ± 0.4410	2.8860 ± 0.2410	3.0001 ± 0.2513
F-3552, 3553	Apr, 1995	Sr-89	-0.0061 ± 0.0064	0.0011 ± 0.0080	-0.0025 ± 0.0051
F-3552, 3553	Apr, 1995	Sr-90	0.0023 ± 0.0029	0.0005 ± 0.0036	0.0014 ± 0.0023
SWT-3343, 3344	Apr, 1995	Gr. Beta	2.3310 ± 0.5190	2.9830 ± 0.4800	2.6570 ± 0.3535
G-3133, 3134	Apr, 1995	K-40	6.5000 ± 0.1740	6.0532 ± 0.3120	6.2766 ± 0.1786
SW-3403, 3404	Apr, 1995	H-3	159.5512 ± 90.5914	72.7069 ± 86.6327	116.1290 ± 62.6738
WW-3424, 3425	Apr, 1995	H-3	442.5093 ± 116.7309	430.4409 ± 116.3142	436.4751 ± 82.3940
LW-3682, 3683	Apr, 1995	Gr. Beta	2.0500 ± 0.5760	1.5240 ± 0.5500	1.7870 ± 0.3982
LW-3682, 3683	Apr, 1995	Gr. Beta	2.0501 ± 0.6760	1.5244 ± 0.5500	1.7872 ± 0.4358
LW-3682, 3683	Apr, 1995	H-3	139.9350 ± 91.1490	75.0380 ± 88.2140	107.4865 ± 63.4229
LW-3682, 3683	Apr, 1995	H-3	75.0378 ± 88.2143	139.9353 ± 91.1494	107.4865 ± 63.4231
SO-3531, 3532	May, 1995	Cs-137	0.1624 ± 0.0246	0.1418 ± 0.0306	0.1521 ± 0.0196
SO-3531, 3532	May, 1995	Gr. Alpha	6.8662 ± 3.5751	9.2164 ± 3.8687	8.0413 ± 2.6338
SO-3531, 3532	May, 1995	Gr. Beta	17.0973 ± 3.0829	18.8034 ± 3.1329	17.9503 ± 2.1977
SO-3531, 3532	May, 1995	K-40	25.0380 ± 0.7710	23.8180 ± 0.6600	24.4280 ± 0.5075
SO-3531, 3532	May, 1995	Sr-89	-0.0129 ± 0.0215	0.0014 ± 0.0202	-0.0057 ± 0.0147
SO-3531, 3532	May, 1995	Sr-90	0.0261 ± 0.0109	0.0122 ± 0.0093	0.0191 ± 0.0072
WW-3577, 3578	May, 1995	Co-60	-0.2530 ± 2.2200	0.5410 ± 2.5800	0.1440 ± 1.7018
WW-3577, 3578	May, 1995	Cs-137	1.1500 ± 2.2000	-1.6400 ± 2.9200	-0.2450 ± 1.8280
WW-3577, 3578	May, 1995	H-3	33.5750 ± 90.9827	58.7563 ± 92.0487	46.1657 ± 64.7125
MI-3598, 3599	May, 1995	I-131	0.2288 ± 0.3515	0.2122 ± 0.3043	0.2205 ± 0.2324
MI-3598, 3599	May, 1995	K-40	1,349.0000 ± 112.0000	1,297.4000 ± 151.0000	1,323.2000 ± 94.0013
MI-3809, 3810	May, 1995	Co-60	-0.3700 ± 2.9600	0.1820 ± 2.9600	-0.0940 ± 2.0930
MI-3809, 3810	May, 1995	Cs-137	0.9060 ± 2.5000	0.1380 ± 2.3600	0.5220 ± 1.7190
MI-3809, 3810	May, 1995	I-131	0.1445 ± 0.1573	0.1738 ± 0.2057	0.1592 ± 0.1295
CW-3838, 3839	May, 1995	Gr. Beta	1.9922 ± 1.3549	3.4291 ± 1.4650	2.7106 ± 0.9977
CW-3838, 3839	May, 1995	Gr. Beta	-0.7347 ± 1.2274	-1.0782 ± 1.2004	-0.9064 ± 0.8584
F-4309, 4310	May, 1995	Co-60	-0.0017 ± 0.0093	-0.0032 ± 0.0166	-0.0024 ± 0.0095

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
F-4309, 4310	May, 1995	Cs-137	0.0028 ± 0.0089	0.0012 ± 0.0133	0.0020 ± 0.0080
F-4288, 4289	May, 1995	Co-60	0.0038 ± 0.0097	0.0012 ± 0.0088	0.0025 ± 0.0065
F-4288, 4289	May, 1995	Cs-137	0.0002 ± 0.0067	0.0022 ± 0.0062	0.0012 ± 0.0045
F-4330, 4331	May, 1995	Co-60	0.0018 ± 0.0046	0.0031 ± 0.0050	0.0024 ± 0.0034
F-4330, 4331	May, 1995	Cs-137	0.0001 ± 0.0042	-0.0007 ± 0.0038	-0.0003 ± 0.0028
MI-4377, 4378	May, 1995	Co-60	0.9480 ± 1.7400	2.2200 ± 2.6600	1.5840 ± 1.5893
MI-4377, 4378	May, 1995	Cs-134	0.7830 ± 1.4900	-0.2080 ± 2.3000	0.2875 ± 1.3702
MI-4377, 4378	May, 1995	Cs-137	0.8740 ± 1.3800	0.6430 ± 2.1400	0.7585 ± 1.2732
MI-4377, 4378	May, 1995	I-131	-0.0785 ± 0.1490	-0.0420 ± 0.1498	-0.0602 ± 0.1056
MI-4377, 4378	May, 1995	I-131(g)	0.1700 ± 1.3000	-1.1200 ± 2.6200	-0.4750 ± 1.4624
MI-4377, 4378	May, 1995	K-40	1,385.1000 ± 63.2000	1,344.3000 ± 92.5000	1,364.7000 ± 56.0145
MI-4377, 4378	May, 1995	Sr-89	-0.0069 ± 0.7313	0.0069 ± 1.1490	0.0000 ± 0.6810
MI-4377, 4378	May, 1995	Sr-90	1.2729 ± 0.4414	1.3229 ± 0.6414	1.2979 ± 0.3893
MI-4544, 4545	May, 1995	I-131	0.0524 ± 0.2867	0.0574 ± 0.2367	0.0549 ± 0.1859
MI-4544, 4545	May, 1995	K-40	1,410.0000 ± 72.3000	1,359.0000 ± 65.7000	1,384.5000 ± 48.8461
MI-4544, 4545	May, 1995	Sr-90	2.1444 ± 0.5153	1.2741 ± 0.4112	1.7093 ± 0.3296
G-4604, 4605	May, 1995	Be-7	1.9338 ± 0.3520	1.7467 ± 0.3580	1.8403 ± 0.2510
G-4604, 4605	May, 1995	Co-60	-0.0112 ± 0.0217	-0.0175 ± 0.0189	-0.0144 ± 0.0144
G-4604, 4605	May, 1995	Cs-134	0.0076 ± 0.0165	0.0079 ± 0.0163	0.0078 ± 0.0116
G-4604, 4605	May, 1995	Cs-137	0.1303 ± 0.0332	0.1283 ± 0.0420	0.1293 ± 0.0268
G-4604, 4605	May, 1995	Gr. Beta	3.9523 ± 0.1425	3.9500 ± 0.1562	3.9512 ± 0.1057
G-4604, 4605	May, 1995	I-131(g)	0.0101 ± 0.0227	0.0055 ± 0.0263	0.0078 ± 0.0174
G-4604, 4605	May, 1995	K-40	5.1487 ± 0.6580	5.1002 ± 0.6970	5.1245 ± 0.4793
CW-4575, 4576	May, 1995	Gr. Beta	1.9783 ± 1.1888	2.8278 ± 1.2558	2.4030 ± 0.8646
CW-4575, 4576	May, 1995	Gr. Beta	-0.2059 ± 1.0000	-0.5589 ± 0.9721	-0.3824 ± 0.6973
MI-4695, 4696	May, 1995	I-131	0.1049 ± 0.1737	0.0942 ± 0.1607	0.0995 ± 0.1183
MI-4695, 4696	May, 1995	K-40	1,568.8000 ± 114.0000	1,573.1000 ± 50.1000	1,570.9500 ± 62.2616
MI-4716, 4717	May, 1995	Sr-89	-0.2701 ± 0.7584	-0.0499 ± 0.8752	-0.1600 ± 0.5790
MI-4716, 4717	May, 1995	Sr-90	1.1720 ± 0.4391	1.6280 ± 0.4432	1.4000 ± 0.3119
G-4814, 4815	May, 1995	Be-7	0.6081 ± 0.2520	0.5837 ± 0.1750	0.5959 ± 0.1534
G-4814, 4815	May, 1995	K-40	5.8319 ± 0.6100	5.1295 ± 0.5050	5.4807 ± 0.3960
WW-4784, 4785	May, 1995	H-3	18,665.3086 ± 390.2155	18,274.9314 ± 386.3294	18,470.1200 ± 274.5535
SW-4759, 4760	May, 1995	H-3	3,679.8217 ± 213.9409	3,817.7847 ± 217.0401	3,748.8032 ± 152.3787
SO-5178, 5179	May, 1995	Cs-137	0.8481 ± 0.0691	0.8110 ± 0.0710	0.8296 ± 0.0495
SO-5178, 5179	May, 1995	K-40	19.9200 ± 1.0800	22.0860 ± 1.1800	21.0030 ± 0.7998
SWU-5663, 5664	May, 1995	Gr. Beta	2.4654 ± 0.6199	2.5106 ± 0.6258	2.4880 ± 0.4404

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SWU-5663, 5664	May, 1995	H-3	867.2182 ± 104.9067	865.5032 ± 104.8506	866.3607 ± 74.1604
BS - 6983, 6984	May, 1995	Gr. Beta	7.3555 ± 1.2333	8.0347 ± 1.4183	7.6951 ± 0.9397
BS - 6983, 6984	May, 1995	Gr. Beta	7.3555 ± 1.2333	8.0347 ± 1.4183	7.6951 ± 0.9397
BS - 6983, 6984	May, 1995	K-40	8.3490 ± 0.3090	8.5309 ± 0.0683	8.4400 ± 0.1582
BS - 6983, 6984	May, 1995	K-40	8.3490 ± 0.3090	8.5309 ± 0.0683	8.4400 ± 0.1582
BS-6983, 6984	May, 1995	Cs-137	0.0074 ± 0.0008	0.0094 ± 0.0024	0.0084 ± 0.0013
BS-6983, 6984	May, 1995	Gr. Beta	7.3555 ± 1.2333	8.0347 ± 1.4183	7.6951 ± 0.9397
BS-6983, 6984	May, 1995	K-40	8.3490 ± 0.3090	8.5309 ± 0.0683	8.4400 ± 0.1582
BS - 5494, 5495	May, 1995	Cs-137	0.5929 ± 0.0319	0.5876 ± 0.0378	0.5903 ± 0.0247
BS - 5494, 5495	May, 1995	Cs-137	0.5929 ± 0.0319	0.5876 ± 0.0378	0.5903 ± 0.0247
BS - 5494, 5495	May, 1995	K-40	21.0920 ± 0.6570	21.3050 ± 0.7070	21.1985 ± 0.4826
BS - 5494, 5495	May, 1995	K-40	21.0920 ± 0.6570	21.3050 ± 0.7070	21.1985 ± 0.4826
BS-5494, 5495	May, 1995	Cs-137	0.5929 ± 0.0319	0.5876 ± 0.0378	0.5903 ± 0.0247
BS-5494, 5495	May, 1995	K-40	21.0920 ± 0.6570	21.3050 ± 0.7070	21.1985 ± 0.4826
F-5025, 5026	May, 1995	Co-60	0.0024 ± 0.0064	0.0028 ± 0.0077	0.0026 ± 0.0050
F-5025, 5026	May, 1995	Cs-137	-0.0006 ± 0.0060	-0.0038 ± 0.0063	-0.0022 ± 0.0040
F-5385, 5386	May, 1995	K-40	2.5044 ± 0.3450	2.5992 ± 0.3830	2.5518 ± 0.2577
F-5046, 5047	May, 1995	Co-60	0.0012 ± 0.0067	-0.0021 ± 0.0073	-0.0004 ± 0.0049
F-5046, 5047	May, 1995	Cs-137	0.0018 ± 0.0053	-0.0003 ± 0.0046	0.0007 ± 0.0035
WW-5244, 5245	May, 1995	H-3	608.3574 ± 96.3200	463.5639 ± 91.1176	535.9606 ± 65.2947
SW-6013, 6014	May, 1995	Co-60	0.8080 ± 2.2000	1.5300 ± 3.0300	1.1690 ± 1.8722
SW-6013, 6014	May, 1995	Cs-137	-0.6750 ± 2.3000	0.4560 ± 2.3200	-0.1095 ± 1.6334
MI-5620, 5621	May, 1995	I-131	0.1589 ± 0.1736	0.0147 ± 0.1644	0.0868 ± 0.1196
MI-5620, 5621	May, 1995	K-40	1,526.2000 ± 119.0000	1,449.3000 ± 162.0000	1,487.7500 ± 100.5050
WW - 5642, 5643	May, 1995	Gr. Alpha	2.3120 ± 2.3250	2.3120 ± 2.3250	2.3120 ± 1.6440
WW - 5642, 5643	May, 1995	Gr. Beta	2.3120 ± 3.2540	2.3120 ± 3.2540	2.3120 ± 2.3009
WW - 5642, 5643	May, 1995	K-40	94.3550 ± 19.8000	58.9910 ± 29.5000	76.6730 ± 17.7644
DW-5738, 5739	May, 1995	Gr. Beta	2.5151 ± 1.1685	3.5614 ± 1.2103	3.0383 ± 0.8411
DW-5738, 5739	May, 1995	I-131	-0.0458 ± 0.1650	-0.0284 ± 0.1486	-0.0371 ± 0.1110
LW-6327, 6328	May, 1995	Gr. Beta	6.4501 ± 1.0293	6.6100 ± 1.0327	6.5300 ± 0.7290
W-6398, 6399	May, 1995	Sr-89	15.1044 ± 3.8169	18.1475 ± 2.7239	16.6259 ± 2.3446
W-6398, 6399	May, 1995	Sr-90	25.0828 ± 1.8532	24.4207 ± 1.3058	24.7518 ± 1.1335
WW-6184, 6185	Jun, 1995	Gr. Beta	6.0148 ± 1.1147	7.4613 ± 1.3560	6.7380 ± 0.8777
WW-6184, 6185	Jun, 1995	H-3	86.1439 ± 78.3469	106.9572 ± 79.2631	96.5505 ± 55.7245
MI-5684, 5685	Jun, 1995	Co-60	0.0976 ± 2.9600	0.4260 ± 4.6300	0.2618 ± 2.7477
MI-5684, 5685	Jun, 1995	Cs-137	1.8400 ± 2.6500	-0.9210 ± 3.2400	0.4595 ± 2.0929

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-5684, 5685	Jun, 1995	I-131	0.0829 ± 0.1477	-0.0025 ± 0.1466	0.0402 ± 0.1041
CW-5713, 5714	Jun, 1995	Gr. Beta	3.1068 ± 1.4397	3.2557 ± 1.4487	3.1812 ± 1.0212
CW-5713, 5714	Jun, 1995	Gr. Beta	0.0491 ± 1.4849	0.3925 ± 1.5076	0.2208 ± 1.0580
SL-5832, 5833	Jun, 1995	Co-60	0.0410 ± 0.0114	0.0585 ± 0.0182	0.0498 ± 0.0107
SL-5832, 5833	Jun, 1995	Cs-137	0.0550 ± 0.0124	0.0499 ± 0.0215	0.0525 ± 0.0124
SL-5832, 5833	Jun, 1995	Gr. Beta	4.6800 ± 0.4800	4.6800 ± 0.4800	4.6800 ± 0.3394
SL-5832, 5833	Jun, 1995	K-40	2.9035 ± 0.2750	2.4429 ± 0.3290	2.6732 ± 0.2144
SL-5832, 5833	Jun, 1995	Sr-89	0.0106 ± 0.0261	0.0048 ± 0.0336	0.0077 ± 0.0213
SL-5832, 5833	Jun, 1995	Sr-90	0.0102 ± 0.0114	0.0164 ± 0.0148	0.0133 ± 0.0093
WW-5992, 5993	Jun, 1995	Co-60	0.3950 ± 1.2200	0.9060 ± 2.6500	0.6505 ± 1.4587
WW-5992, 5993	Jun, 1995	Cs-137	-1.4000 ± 1.3800	-1.4400 ± 3.0300	-1.4200 ± 1.6647
WW-5992, 5993	Jun, 1995	H-3	67.0084 ± 76.1576	94.0370 ± 77.3473	80.5227 ± 54.2738
SL-6205, 6206	Jun, 1995	Co-60	0.0029 ± 0.0088	0.0111 ± 0.0120	0.0070 ± 0.0074
SL-6205, 6206	Jun, 1995	Cs-134	0.0033 ± 0.0070	0.0002 ± 0.0096	0.0018 ± 0.0059
SL-6205, 6206	Jun, 1995	Cs-137	0.0138 ± 0.0091	0.0174 ± 0.0104	0.0156 ± 0.0069
SL-6205, 6206	Jun, 1995	Gr. Beta	3.3400 ± 0.1000	3.3400 ± 0.1000	3.3400 ± 0.0707
SL-6205, 6206	Jun, 1995	I-131(g)	-0.0060 ± 0.0135	-0.0003 ± 0.0197	-0.0031 ± 0.0119
SL-6205, 6206	Jun, 1995	K-40	3.3386 ± 0.3100	3.3294 ± 0.3780	3.3340 ± 0.2444
SW-6256, 6257	Jun, 1995	H-3	423.9034 ± 92.0134	585.0329 ± 97.8935	504.4682 ± 67.1744
MI-6277, 6278	Jun, 1995	I-131	0.0926 ± 0.1619	0.0532 ± 0.2284	0.0729 ± 0.1400
MI-6277, 6278	Jun, 1995	K-40	1,285.5000 ± 152.0000	1,355.2000 ± 114.0000	1,320.3500 ± 95.0000
SW-6232, 6233	Jun, 1995	H-3	68.3732 ± 79.4680	136.7465 ± 82.4296	102.5599 ± 57.2490
VE-6348, 6349	Jun, 1995	Gr. Alpha	0.3230 ± 0.0990	0.1780 ± 0.0520	0.2505 ± 0.0559
VE-6348, 6349	Jun, 1995	Gr. Beta	3.2970 ± 0.1410	3.4170 ± 0.0920	3.3570 ± 0.0842
VE-6348, 6349	Jun, 1995	K-40	3.1425 ± 0.3310	2.9775 ± 0.3350	3.0600 ± 0.2355
MI-6419, 6420	Jun, 1995	I-131	0.1154 ± 0.1633	0.1197 ± 0.1806	0.1175 ± 0.1217
MI-6419, 6420	Jun, 1995	K-40	1,457.2000 ± 175.0000	1,339.3000 ± 150.0000	1,398.2500 ± 115.2443
MI-6521, 6522	Jun, 1995	I-131	0.0534 ± 0.1511	0.0344 ± 0.1784	0.0439 ± 0.1169
MI-6521, 6522	Jun, 1995	K-40	1,475.4000 ± 123.0000	1,274.6000 ± 160.0000	1,375.0000 ± 100.9071
SL-6500, 6501	Jun, 1995	K-40	1.8001 ± 0.4550	2.1667 ± 0.5460	1.9834 ± 0.3554
MI-6446, 6447	Jun, 1995	Co-60	0.1640 ± 4.8700	0.4440 ± 2.8200	0.3040 ± 2.8138
MI-6446, 6447	Jun, 1995	Cs-137	1.3000 ± 3.3600	0.0563 ± 2.1800	0.6782 ± 2.0026
MI-6446, 6447	Jun, 1995	I-131	-0.0433 ± 0.7077	0.0000 ± 0.2377	-0.0217 ± 0.1578
CW-6474, 6475	Jun, 1995	Gr. Beta	2.8423 ± 1.4039	3.1674 ± 1.4145	3.0049 ± 0.9965
CW-6474, 6475	Jun, 1995	Gr. Beta	0.0000 ± 1.1519	0.0909 ± 1.1588	0.0455 ± 0.8170
MI-6564, 6565	Jun, 1995	I-131	0.2460 ± 0.2607	0.0948 ± 0.2353	0.1704 ± 0.1756

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
BS-6960, 6961	Jun, 1995	Cs-137	0.0752 ± 0.0292	0.0475 ± 0.0274	0.0613 ± 0.0200
BS-6960, 6961	Jun, 1995	K-40	17.6680 ± 0.8700	17.0190 ± 1.0600	17.3435 ± 0.6857
WW-6861, 6862	Jun, 1995	H-3	1,422.4460 ± 128.0232	1,505.1361 ± 130.2761	1,463.7910 ± 91.3261
MI-6840, 6841	Jun, 1995	I-131	0.1583 ± 0.2131	0.0509 ± 0.1801	0.1046 ± 0.1395
LW-6889, 6890	Jun, 1995	Co-60	-2.4000 ± 3.4100	1.4300 ± 1.7400	-0.4850 ± 1.9141
LW-6889, 6890	Jun, 1995	Cs-137	-0.5210 ± 3.0300	0.1410 ± 2.1900	-0.1900 ± 1.8693
LW-6889, 6890	Jun, 1995	Gr. Beta	3.0131 ± 0.8315	3.0285 ± 0.8358	3.0208 ± 0.5895
SW-7053, 7054	Jun, 1995	H-3	73.2226 ± 75.6858	126.8001 ± 78.1734	100.0114 ± 54.4046
SW-7011, 7012	Jun, 1995	H-3	203.5633 ± 81.5943	226.7766 ± 82.6041	215.1699 ± 58.0540
MI-7032, 7033	Jun, 1995	I-131	0.2720 ± 0.2879	-0.0925 ± 0.2629	0.0897 ± 0.1949
MI-7032, 7033	Jun, 1995	K-40	1,577.6000 ± 127.0000	1,522.8000 ± 164.0000	1,550.2000 ± 103.7123
SWU-7101, 7102	Jun, 1995	Gr. Beta	1.9679 ± 0.4592	2.1339 ± 0.5061	2.0509 ± 0.3417
SWU-7101, 7102	Jun, 1995	H-3	118.5873 ± 85.7967	92.6463 ± 84.6688	105.6168 ± 60.2700
SWU - 7828, 7829	Jun, 1995	Sr-89	0.5896 ± 0.7987	0.0977 ± 0.6691	0.3436 ± 0.5210
SWU - 7828, 7829	Jun, 1995	Sr-90	0.2398 ± 0.3028	0.1937 ± 0.2742	0.2168 ± 0.2042
SWU - 7828, 7829	Jun, 1995	Sr-90	0.2398 ± 0.3028	0.1937 ± 0.2742	0.2168 ± 0.2042
SWU-7828, 7829	Jun, 1995	Sr-89	0.5896 ± 0.7987	0.0977 ± 0.6691	0.3436 ± 0.5210
SWU-7828, 7829	Jun, 1995	Sr-89	0.5896 ± 0.7987	0.0977 ± 0.6691	0.3436 ± 0.5210
SWU-7828, 7829	Jun, 1995	Sr-89	0.5896 ± 0.7987	0.0977 ± 0.6691	0.3436 ± 0.5210
SWU-7828, 7829	Jun, 1995	Sr-89	0.5896 ± 0.7987	0.0977 ± 0.6691	0.3436 ± 0.5210
SWU-7828, 7829	Jun, 1995	Sr-90	0.2398 ± 0.3028	0.1937 ± 0.2742	0.2168 ± 0.2042
SWU-7828, 7829	Jun, 1995	Sr-90	0.2398 ± 0.3028	0.1937 ± 0.2742	0.2168 ± 0.2042
SWU-7828, 7829	Jun, 1995	Sr-90	0.2398 ± 0.3028	0.1937 ± 0.2742	0.2168 ± 0.2042
SWU-7828, 7829	Jun, 1995	Sr-90	0.2398 ± 0.3028	0.1937 ± 0.2742	0.2168 ± 0.2042
AP-8111, 8112	Jun, 1995	Co-60	-0.0002 ± 0.0007	0.0004 ± 0.0007	0.0001 ± 0.0005
AP-8111, 8112	Jun, 1995	Cs-137	-0.0002 ± 0.0007	0.0004 ± 0.0005	0.0001 ± 0.0004
SW-7080, 7081	Jun, 1995	Gr. Beta	2.3011 ± 0.5921	2.6708 ± 0.6113	2.4860 ± 0.4255
SW-7080, 7081	Jun, 1995	K-40	61.2620 ± 28.3000	95.4390 ± 26.0000	78.3505 ± 19.2152
WWT-7122, 7123	Jun, 1995	H-3	3.8386 ± 81.4299	-13.4353 ± 80.6115	-4.7983 ± 57.2910
LW-7239, 7240	Jun, 1995	Gr. Beta	2.5177 ± 0.0580	2.4081 ± 0.6061	2.4629 ± 0.3044
WW-7143, 7144	Jun, 1995	H-3	539.1386 ± 103.3228	436.4159 ± 99.5398	487.7772 ± 71.7352
PW-7174, 7175	Jun, 1995	H-3	144.0732 ± 84.2861	121.4242 ± 83.2655	132.7487 ± 59.2395
SW-7216, 7217	Jun, 1995	H-3	20.3728 ± 81.4069	62.9704 ± 83.3227	41.6716 ± 58.2446
WW-7281, 7282	Jun, 1995	Gr. Beta	1.8051 ± 0.3271	2.1056 ± 0.5796	1.9553 ± 0.3328
WW-7281, 7282	Jun, 1995	H-3	-24.3250 ± 75.1716	10.3381 ± 76.8357	-6.9934 ± 53.7459
SW-7387, 7388	Jul, 1995	Co-60	1.0200 ± 1.9000	0.1530 ± 1.6700	0.5865 ± 1.2648

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SW-7387, 7388	Jul, 1995	Cs-137	0.5600 ± 2.3400	-0.8650 ± 2.0400	-0.1525 ± 1.5522
AP-8133, 8134	Jul, 1995	Co-60	-0.0000 ± 0.0005	0.0003 ± 0.0006	0.0001 ± 0.0004
AP-8133, 8134	Jul, 1995	Cs-137	-0.0001 ± 0.0004	0.0000 ± 0.0005	-0.0001 ± 0.0003
AP-7600, 7601	Jul, 1995	Sr-89	0.0008 ± 0.0008	0.0010 ± 0.0008	0.0009 ± 0.0005
AP-7600, 7601	Jul, 1995	Sr-90	-0.0001 ± 0.0003	0.0005 ± 0.0003	0.0002 ± 0.0002
MI-7260, 7261	Jul, 1995	Co-60	0.3390 ± 2.9100	0.5630 ± 5.2400	0.4510 ± 2.9969
MI-7260, 7261	Jul, 1995	Cs-137	1.6600 ± 2.5900	-1.4600 ± 3.3700	0.1000 ± 2.1251
MI-7260, 7261	Jul, 1995	I-131	0.1745 ± 0.1944	0.1004 ± 0.1792	0.1374 ± 0.1322
WW-7454, 7455	Jul, 1995	H-3	7,142.7529 ± 243.6211	6,985.4236 ± 241.2186	7,064.0882 ± 171.4188
LW - 7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW - 7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	Co-60	0.4460 ± 1.0700	0.3830 ± 3.0000	0.4145 ± 1.5926
LW-7487, 7488	Jul, 1995	Cs-134	0.1230 ± 1.0600	-2.3900 ± 3.0100	-1.1335 ± 1.5956
LW-7487, 7488	Jul, 1995	Cs-137	0.4920 ± 1.1000	-2.2200 ± 2.8400	-0.8640 ± 1.5228
LW-7487, 7488	Jul, 1995	Gr. Beta	2.1095 ± 0.4725	1.8520 ± 0.4810	1.9807 ± 0.3371
LW-7487, 7488	Jul, 1995	I-131	0.2323 ± 0.2677	-0.0343 ± 0.2508	0.0990 ± 0.1834
LW-7487, 7488	Jul, 1995	I-131(g)	0.3390 ± 2.4400	0.9230 ± 10.5000	0.6310 ± 5.3899
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
SW-7323, 7324	Jul, 1995	Gr. Beta	2.3224 ± 0.7511	2.5774 ± 0.7631	2.4499 ± 0.5354
SW-7323, 7324	Jul, 1995	H-3	77.8879 ± 83.9931	48.4345 ± 82.6045	63.1612 ± 58.9032
F-7366, 7367	Jul, 1995	Co-60	0.0092 ± 0.0141	0.0061 ± 0.0119	0.0076 ± 0.0092
F-7366, 7367	Jul, 1995	Cs-137	0.0115 ± 0.0108	0.0019 ± 0.0111	0.0067 ± 0.0077
MI-7510, 7511	Jul, 1995	I-131	0.3443 ± 0.3987	0.1361 ± 0.3508	0.2402 ± 0.2655
F-7344, 7345	Jul, 1995	Co-60	0.0037 ± 0.0077	-0.0071 ± 0.0119	-0.0017 ± 0.0071
F-7344, 7345	Jul, 1995	Cs-137	0.0023 ± 0.0057	0.0024 ± 0.0097	0.0023 ± 0.0056
MI-7429, 7430	Jul, 1995	I-131	-0.1525 ± 0.3171	0.1594 ± 0.2283	0.0035 ± 0.1953
F-8154, 8155	Jul, 1995	Gr. Beta	2.3081 ± 0.0743	2.2522 ± 0.0730	2.2802 ± 0.0521
F-8154, 8155	Jul, 1995	K-40	2.2313 ± 0.2640	2.1161 ± 0.4420	2.1737 ± 0.2574
MI-7575, 7576	Jul, 1995	Co-60	-1.0000 ± 2.8600	1.6000 ± 3.1700	0.3000 ± 2.1347
MI-7575, 7576	Jul, 1995	Cs-134	1.7300 ± 2.4200	-0.6220 ± 2.3600	0.5540 ± 1.6901
MI-7575, 7576	Jul, 1995	Cs-137	-0.7550 ± 2.5100	1.2800 ± 2.3800	0.2625 ± 1.7295
MI-7575, 7576	Jul, 1995	I-131	0.1795 ± 0.2309	0.0704 ± 0.2260	0.1250 ± 0.1616
MI-7575, 7576	Jul, 1995	I-131(g)	0.8570 ± 2.2400	0.8540 ± 2.4400	0.8555 ± 1.6561

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-7575, 7576	Jul, 1995	K-40	1,481.9000 ± 111.0000	1,398.8000 ± 106.0000	1,440.3500 ± 76.7414
MI-7575, 7576	Jul, 1995	Sr-89	0.6192 ± 0.9862	-0.5435 ± 0.9244	0.0378 ± 0.6758
MI-7575, 7576	Jul, 1995	Sr-90	1.2363 ± 0.4155	1.7902 ± 0.4124	1.5133 ± 0.2927
WWT-7621, 7622	Jul, 1995	I-131	0.0940 ± 0.2062	0.0628 ± 0.2223	0.0784 ± 0.1516
MI-7739, 7740	Jul, 1995	Co-60	0.8900 ± 4.9100	-0.5720 ± 4.5800	0.1590 ± 3.3572
MI-7739, 7740	Jul, 1995	Cs-137	0.8600 ± 3.7300	-0.4130 ± 3.1400	0.2235 ± 2.4379
MI-7739, 7740	Jul, 1995	I-131	0.1928 ± 0.2674	-0.0475 ± 0.2351	0.0727 ± 0.1780
G-7805, 7806	Jul, 1995	Co-60	-0.0049 ± 0.0159	0.0015 ± 0.0156	-0.0017 ± 0.0111
G-7805, 7806	Jul, 1995	Cs-134	-0.0076 ± 0.0157	0.0025 ± 0.0094	-0.0025 ± 0.0091
G-7805, 7806	Jul, 1995	Cs-137	0.0045 ± 0.0140	0.0006 ± 0.0118	0.0026 ± 0.0092
G-7805, 7806	Jul, 1995	Gr. Beta	5.0973 ± 0.1994	5.1127 ± 0.2103	5.1050 ± 0.1449
G-7805, 7806	Jul, 1995	I-131(g)	-0.0048 ± 0.0205	-0.0183 ± 0.0205	-0.0115 ± 0.0145
G-7805, 7806	Jul, 1995	K-40	6.0481 ± 0.5610	5.8484 ± 0.5100	5.9483 ± 0.3791
CW-7648, 7649	Jul, 1995	Gr. Beta	6.6883 ± 1.7265	6.7478 ± 1.7419	6.7181 ± 1.2263
CW-7648, 7649	Jul, 1995	Gr. Beta	0.7444 ± 1.2623	0.2325 ± 1.2230	0.4885 ± 0.8788
CW-7648, 7649	Jul, 1995	H-3	-64.4182 ± 97.4643	-70.1870 ± 97.2364	-67.3026 ± 68.8371
WW-7673, 7674	Jul, 1995	Gr. Beta	14.1451 ± 2.2254	14.2212 ± 2.2315	14.1831 ± 1.5757
WW-7673, 7674	Jul, 1995	H-3	15.3145 ± 81.7571	36.3720 ± 82.7373	25.8432 ± 58.1586
MI-7896, 7897	Jul, 1995	Sr-89	0.3508 ± 0.9697	0.1856 ± 0.8702	0.2682 ± 0.6514
MI-7896, 7897	Jul, 1995	Sr-90	1.7110 ± 0.4271	1.2961 ± 0.3929	1.5036 ± 0.2902
WW-7967, 7968	Jul, 1995	H-3	109.4679 ± 84.6270	70.8322 ± 82.8444	90.1500 ± 59.2134
MI-7922, 7923	Jul, 1995	Co-60	0.5680 ± 3.1300	-1.0500 ± 4.4600	-0.2410 ± 2.7244
MI-7922, 7923	Jul, 1995	Cs-137	1.2100 ± 2.8600	-0.5040 ± 3.4200	0.3530 ± 2.2291
MI-7922, 7923	Jul, 1995	I-131	0.0502 ± 0.1932	0.0416 ± 0.2336	0.0459 ± 0.1516
LW-7944, 7945	Jul, 1995	Co-60	0.0830 ± 2.2000	1.3000 ± 1.8900	0.6915 ± 1.4502
LW-7944, 7945	Jul, 1995	Cs-137	0.6400 ± 2.2200	-1.3800 ± 1.8200	-0.3700 ± 1.4353
LW-7944, 7945	Jul, 1995	Gr. Beta	4.1332 ± 0.9251	3.9971 ± 0.9393	4.0652 ± 0.6592
SW-8704, 8705	Jul, 1995	Co-60	0.1830 ± 2.4900	0.9840 ± 1.7900	0.5835 ± 1.5333
SW-8704, 8705	Jul, 1995	Cs-137	0.2640 ± 3.4500	-0.6630 ± 1.9100	-0.1995 ± 1.9717
WW-8196, 8197	Jul, 1995	H-3	51.4226 ± 87.9172	176.0234 ± 93.3551	113.7230 ± 64.1183
SWU-8318, 8319	Jul, 1995	Gr. Beta	1.9584 ± 0.4714	1.9228 ± 0.4731	1.9406 ± 0.3340
SWU-8318, 8319	Jul, 1995	H-3	102.7030 ± 103.6806	35.5141 ± 101.1620	69.1086 ± 72.4283
SWU-8318, 8319	Jul, 1995	K-40	93.2530 ± 39.7000	99.7420 ± 49.1000	96.4975 ± 31.5710
SP-8540, 8541	Jul, 1995	Gr. Alpha	5.1903 ± 1.3072	3.8567 ± 1.0701	4.5235 ± 0.8447
SP-8540, 8541	Jul, 1995	Sr-89	1,443.0886 ± 42.0809	1,419.4750 ± 35.3491	1,431.2818 ± 27.4789
SP-8540, 8541	Jul, 1995	Sr-90	15.7496 ± 3.7553	19.4328 ± 4.1309	17.5912 ± 2.7914

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
VE-8090, 8091	Jul, 1995	Gr. Beta	2.3819 ± 0.0781	2.3059 ± 0.0779	2.3439 ± 0.0552
VE-8090, 8091	Jul, 1995	K-40	2.8208 ± 0.1170	2.7639 ± 0.1330	2.7924 ± 0.0886
SW-8175, 8176	Jul, 1995	Gr. Alpha	0.5000 ± 0.6000	0.6583 ± 0.8198	0.5791 ± 0.5080
SW-8175, 8176	Jul, 1995	Gr. Beta	0.8100 ± 1.1000	0.8265 ± 1.0847	0.8182 ± 0.7724
SW-8175, 8176	Jul, 1995	K-40	89.8150 ± 23.8000	67.3590 ± 39.3000	78.5870 ± 22.9724
SW-8251, 8252	Jul, 1995	H-3	86.7952 ± 78.8856	43.9921 ± 76.9259	65.3937 ± 55.0921
SW-8606, 8607	Jul, 1995	Co-60	0.1320 ± 1.7100	-0.2180 ± 2.6000	-0.0430 ± 1.5560
SW 8606, 8607	Jul, 1995	Cs-137	-1.0400 ± 2.0400	-0.6580 ± 2.2400	-0.8490 ± 1.5149
G - 8272, 8273	Aug, 1995	K-40	6.7487 ± 0.6490	6.6636 ± 0.9730	6.7062 ± 0.5848
G - 8272, 8273	Aug, 1995	Sr-89	0.0014 ± 0.0091	-0.0007 ± 0.0029	0.0004 ± 0.0048
G - 8272, 8273	Aug, 1995	Sr-90	0.0053 ± 0.0029	0.0016 ± 0.0012	0.0034 ± 0.0016
G-8272, 8273	Aug, 1995	Gr. Beta	6.2167 ± 0.2594	5.9667 ± 0.2551	6.0917 ± 0.1819
MI-8293, 8294	Aug, 1995	I-131	-0.1058 ± 0.1908	0.0093 ± 0.2009	-0.0483 ± 0.1385
MI-8389, 8390	Aug, 1995	I-131	-0.0127 ± 0.1267	0.1153 ± 0.1318	0.0513 ± 0.0914
MI-8389, 8390	Aug, 1995	K-40	1,543.8000 ± 120.0000	1,369.6000 ± 162.0000	1,456.7000 ± 100.8018
MI-8413, 8414	Aug, 1995	Co-60	0.2940 ± 3.1400	-2.3500 ± 5.2200	-1.0280 ± 3.0458
MI-8413, 8414	Aug, 1995	Cs-137	-0.7370 ± 2.8900	-1.3600 ± 3.3100	-1.0485 ± 2.1971
MI-8413, 8414	Aug, 1995	I-131	0.1142 ± 0.2124	0.0598 ± 0.2344	0.0870 ± 0.1581
LW-8440, 8441	Aug, 1995	Co-60	0.1030 ± 2.3800	1.0300 ± 1.8100	0.5665 ± 1.4950
LW-8440, 8441	Aug, 1995	Cs-137	0.7760 ± 1.9900	-0.3890 ± 2.0500	0.1935 ± 1.4285
LW-8440, 8441	Aug, 1995	Gr. Beta	3.3064 ± 1.1388	4.6623 ± 1.2154	3.9844 ± 0.8327
WW-8518, 8519	Aug, 1995	Co-60	1.4700 ± 3.1400	-1.8100 ± 2.9800	-0.1700 ± 2.1645
WW-8518, 8519	Aug, 1995	Cs-137	1.7100 ± 2.8700	0.4430 ± 2.7700	1.0765 ± 1.9944
WW-8518, 8519	Aug, 1995	H-3	10.6795 ± 74.0469	-19.5791 ± 72.5777	-4.4498 ± 51.8422
VE-8564, 8565	Aug, 1995	Co-60	0.0053 ± 0.0122	0.0054 ± 0.0128	0.0053 ± 0.0088
VE-8564, 8565	Aug, 1995	Cs-137	0.0038 ± 0.0093	-0.0003 ± 0.0082	0.0018 ± 0.0062
MI-8585, 8586	Aug, 1995	Co-60	-0.4810 ± 4.0600	1.8800 ± 2.5900	0.6995 ± 2.4079
MI-8585, 8586	Aug, 1995	Cs-134	0.1220 ± 3.5000	0.9370 ± 2.2700	0.5295 ± 2.0858
MI-8585, 8586	Aug, 1995	Cs-137	1.7700 ± 3.6400	0.2160 ± 2.0700	0.9930 ± 2.0937
MI-8585, 8586	Aug, 1995	I-131	-0.2002 ± 0.2079	0.0732 ± 0.1900	-0.0635 ± 0.1408
MI-8585, 8586	Aug, 1995	I-131(g)	0.1360 ± 9.0300	2.4300 ± 6.8100	1.2830 ± 5.6550
MI-8585, 8586	Aug, 1995	K-40	1,454.6000 ± 150.0000	1,478.2000 ± 104.0000	1,466.4000 ± 91.2634
MI-8585, 8586	Aug, 1995	Sr-89	0.1158 ± 1.1111	-0.0833 ± 0.9491	0.0162 ± 0.7306
MI-8585, 8586	Aug, 1995	Sr-90	1.9078 ± 0.4296	1.6029 ± 0.3807	1.7553 ± 0.2870
MI-8674, 8675	Aug, 1995	Co-60	-0.7910 ± 3.2300	0.4890 ± 3.3400	-0.1510 ± 2.3232
MI-8674, 8675	Aug, 1995	Cs-137	0.7690 ± 2.4300	0.4160 ± 2.4000	0.5925 ± 1.7077

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a]		
			First Result	Second Result	Averaged Result
MI-8674, 8675	Aug, 1995	I-131	0.1471 ± 0.2525	-0.0869 ± 0.2167	0.0301 ± 0.1664
SW-8648, 8649	Aug, 1995	H-3	35.5546 ± 75.1429	21.3328 ± 74.4670	28.4437 ± 52.8956
F-8754, 8755	Aug, 1995	Co-60	0.0009 ± 0.0110	0.0031 ± 0.0106	0.0020 ± 0.0076
F-8754, 8755	Aug, 1995	Cs-134	-0.0026 ± 0.0090	-0.0022 ± 0.0087	-0.0024 ± 0.0063
F-8754, 8755	Aug, 1995	Cs-137	0.0528 ± 0.0207	0.0563 ± 0.0171	0.0546 ± 0.0134
F-8754, 8755	Aug, 1995	Gr. Beta	13.1178 ± 0.3041	12.6488 ± 0.2780	12.8833 ± 0.2060
F-8754, 8755	Aug, 1995	I-131(g)	0.0026 ± 0.0139	0.0013 ± 0.0121	0.0019 ± 0.0092
F-8754, 8755	Aug, 1995	K-40	2.8119 ± 0.3670	3.2605 ± 0.3670	3.0362 ± 0.2595
VE-8946, 8947	Aug, 1995	Gr. Alpha	0.2000 ± 0.0800	0.2018 ± 0.0786	0.2009 ± 0.0561
VE-8946, 8947	Aug, 1995	Gr. Beta	4.3000 ± 0.1500	4.3179 ± 0.1511	4.3089 ± 0.1065
VE-8946, 8947	Aug, 1995	K-40	3.9615 ± 0.2670	4.0418 ± 0.3300	4.0017 ± 0.2122
VE - 8802, 8803	Aug, 1995	Sr-89	-0.0001 ± 0.0018	-0.0004 ± 0.0022	-0.0002 ± 0.0014
VE - 8802, 8803	Aug, 1995	Sr-90	0.0011 ± 0.0006	0.0013 ± 0.0007	0.0012 ± 0.0005
VE-8802, 8803	Aug, 1995	K-40	2.3052 ± 0.2360	2.3039 ± 0.3070	2.3046 ± 0.1936
MI-8845, 8846	Aug, 1995	I-131	0.0098 ± 0.1785	0.0835 ± 0.1740	0.0467 ± 0.1246
CW-8873, 8874	Aug, 1995	Gr. Beta	1.8586 ± 1.3992	4.2592 ± 1.5511	3.0589 ± 1.0445
CW-8873, 8874	Aug, 1995	Gr. Beta	-0.6043 ± 1.1348	-0.0465 ± 1.1799	-0.3254 ± 0.8185
MI-8902, 8903	Aug, 1995	I-131	-0.0387 ± 0.2325	0.1320 ± 0.3198	0.0466 ± 0.1977
VE-9035, 9036	Aug, 1995	K-40	2.1934 ± 0.2790	2.3847 ± 0.3380	2.2891 ± 0.2191
SW-9056, 9057	Aug, 1995	H-3	140.7425 ± 79.5937	55.2281 ± 75.6687	97.9853 ± 54.9111
MI-9113, 9114	Aug, 1995	I-131	0.2205 ± 0.3289	0.2711 ± 0.2835	0.2458 ± 0.2171
LW-9079, 9080	Aug, 1995	Co-60	0.8410 ± 2.8400	0.1630 ± 2.9900	0.5020 ± 2.0619
LW-9079, 9080	Aug, 1995	Cs-137	0.7700 ± 2.7700	-0.5330 ± 2.6700	0.1185 ± 1.9237
LW-9079, 9080	Aug, 1995	Gr. Beta	2.7566 ± 0.8607	2.6961 ± 0.8549	2.7264 ± 0.6065
SW-9183, 9184	Aug, 1995	Co-60	-0.3280 ± 3.0000	2.2200 ± 4.0400	0.9460 ± 2.5160
SW-9183, 9184	Aug, 1995	Cs-137	0.8200 ± 3.4400	0.2580 ± 4.3700	0.5390 ± 2.7808
SWU-9162, 9163	Aug, 1995	Gr. Beta	2.5000 ± 0.5000	2.5094 ± 0.5480	2.5047 ± 0.3709
SWU-9162, 9163	Aug, 1995	H-3	152.0000 ± 88.0000	157.4341 ± 83.7394	154.7170 ± 60.7377
WW-9276, 9277	Aug, 1995	H-3	1,636.0299 ± 130.9904	1,680.8118 ± 132.2095	1,658.4209 ± 93.0562
VE-9210, 9211	Aug, 1995	Gr. Beta	4.1000 ± 0.2000	4.0920 ± 0.1675	4.0960 ± 0.1304
VE-9210, 9211	Aug, 1995	K-40	4.6449 ± 0.1090	4.6203 ± 0.1150	4.6326 ± 0.0792
DW-9371, 9372	Aug, 1995	Gr. Beta	4.9900 ± 1.1960	4.5327 ± 1.1679	4.7613 ± 0.8358
DW-9371, 9372	Aug, 1995	I-131	0.1312 ± 0.2093	0.1381 ± 0.1961	0.1346 ± 0.1434
MI-9297, 9298	Aug, 1995	I-131	0.0434 ± 0.1996	0.0510 ± 0.2134	0.0472 ± 0.1461
MI-9297, 9298	Aug, 1995	K-40	1,727.8000 ± 180.0000	1,602.7000 ± 172.0000	1,665.2500 ± 124.4829
WW-9252, 9253	Sep, 1995	H-3	530.8948 ± 98.7085	538.0449 ± 98.9671	534.4698 ± 69.8889

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
SW-7387, 7388	Jul, 1995	Cs-137	0.5600 ± 2.3400	-0.8650 ± 2.0400	-0.1525 ± 1.5522
AP-8133, 8134	Jul, 1995	Co-60	-0.0000 ± 0.0005	0.0003 ± 0.0006	0.0001 ± 0.0004
AP-8133, 8134	Jul, 1995	Cs-137	-0.0001 ± 0.0004	0.0000 ± 0.0005	-0.0001 ± 0.0003
AP-7600, 7601	Jul, 1995	Sr-89	0.0008 ± 0.0008	0.0010 ± 0.0008	0.0009 ± 0.0005
AP-7600, 7601	Jul, 1995	Sr-90	-0.0001 ± 0.0003	0.0005 ± 0.0003	0.0002 ± 0.0002
MI-7260, 7261	Jul, 1995	Co-60	0.3390 ± 2.9100	0.5630 ± 5.2400	0.4510 ± 2.9969
MI-7260, 7261	Jul, 1995	Cs-137	1.6600 ± 2.5900	-1.4600 ± 3.3700	0.1000 ± 2.1251
MI-7260, 7261	Jul, 1995	I-131	0.1745 ± 0.1944	0.1004 ± 0.1792	0.1374 ± 0.1322
WW-7454, 7455	Jul, 1995	H-3	7,142.7529 ± 243.6211	6,985.4236 ± 241.2186	7,064.0882 ± 171.4188
LW - 7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW - 7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	Co-60	0.4460 ± 1.0700	0.3830 ± 3.0000	0.4145 ± 1.5926
LW-7487, 7488	Jul, 1995	Cs-134	0.1230 ± 1.0600	-2.3900 ± 3.0100	-1.1335 ± 1.5956
LW-7487, 7488	Jul, 1995	Cs-137	0.4920 ± 1.1000	-2.2200 ± 2.8400	-0.8640 ± 1.5228
LW-7487, 7488	Jul, 1995	Gr. Beta	2.1095 ± 0.4725	1.8520 ± 0.4810	1.9807 ± 0.3371
LW-7487, 7488	Jul, 1995	I-131	0.2323 ± 0.2677	-0.0343 ± 0.2508	0.0990 ± 0.1834
LW-7487, 7488	Jul, 1995	I-131(g)	0.3390 ± 2.4400	0.9230 ± 10.5000	0.6310 ± 5.3899
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
LW-7487, 7488	Jul, 1995	K-40	48.0000 ± 14.4000	95.7520 ± 39.9000	71.8760 ± 21.2095
SW-7323, 7324	Jul, 1995	Gr. Beta	2.3224 ± 0.7511	2.5774 ± 0.7631	2.4499 ± 0.5354
SW-7323, 7324	Jul, 1995	H-3	77.8879 ± 83.9931	48.4345 ± 82.6045	63.1612 ± 58.9032
F-7366, 7367	Jul, 1995	Co-60	0.0092 ± 0.0141	0.0061 ± 0.0119	0.0076 ± 0.0092
F-7366, 7367	Jul, 1995	Cs-137	0.0115 ± 0.0108	0.0019 ± 0.0111	0.0067 ± 0.0077
MI-7510, 7511	Jul, 1995	I-131	0.3443 ± 0.3987	0.1361 ± 0.3508	0.2402 ± 0.2655
F-7344, 7345	Jul, 1995	Co-60	0.0037 ± 0.0077	-0.0071 ± 0.0119	-0.0017 ± 0.0071
F-7344, 7345	Jul, 1995	Cs-137	0.0023 ± 0.0057	0.0024 ± 0.0097	0.0023 ± 0.0056
MI-7429, 7430	Jul, 1995	I-131	-0.1525 ± 0.3171	0.1594 ± 0.2283	0.0035 ± 0.1953
F-8154, 8155	Jul, 1995	Gr. Beta	2.3081 ± 0.0743	2.2522 ± 0.0730	2.2802 ± 0.0521
F-8154, 8155	Jul, 1995	K-40	2.2313 ± 0.2640	2.1161 ± 0.4420	2.1737 ± 0.2574
MI-7575, 7576	Jul, 1995	Co-60	-1.0000 ± 2.8600	1.6000 ± 3.1700	0.3000 ± 2.1347
MI-7575, 7576	Jul, 1995	Cs-134	1.7300 ± 2.4200	-0.6220 ± 2.3600	0.5540 ± 1.6901
MI-7575, 7576	Jul, 1995	Cs-137	-0.7550 ± 2.5100	1.2800 ± 2.3800	0.2625 ± 1.7295
MI-7575, 7576	Jul, 1995	I-131	0.1795 ± 0.2309	0.0704 ± 0.2260	0.1250 ± 0.1616
MI-7575, 7576	Jul, 1995	I-131(g)	0.8570 ± 2.2400	0.8540 ± 2.4400	0.8555 ± 1.6561

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-7575, 7576	Jul, 1995	K-40	1,481.9000 ± 111.0000	1,398.8000 ± 106.0000	1,440.3500 ± 76.7414
MI-7575, 7576	Jul, 1995	Sr-89	0.6192 ± 0.9862	-0.5435 ± 0.9244	0.0378 ± 0.6758
MI-7575, 7576	Jul, 1995	Sr-90	1.2363 ± 0.4155	1.7902 ± 0.4124	1.5133 ± 0.2927
WWT-7621, 7622	Jul, 1995	I-131	0.0940 ± 0.2062	0.0628 ± 0.2223	0.0784 ± 0.1516
MI-7739, 7740	Jul, 1995	Co-60	0.8900 ± 4.9100	-0.5720 ± 4.5800	0.1590 ± 3.3572
MI-7739, 7740	Jul, 1995	Cs-137	0.8600 ± 3.7300	-0.4130 ± 3.1400	0.2235 ± 2.4379
MI-7739, 7740	Jul, 1995	I-131	0.1928 ± 0.2674	-0.0475 ± 0.2351	0.0727 ± 0.1780
G-7805, 7806	Jul, 1995	Co-60	-0.0049 ± 0.0159	0.0015 ± 0.0156	-0.0017 ± 0.0111
G-7805, 7806	Jul, 1995	Cs-134	-0.0076 ± 0.0157	0.0025 ± 0.0094	-0.0025 ± 0.0091
G-7805, 7806	Jul, 1995	Cs-137	0.0045 ± 0.0140	0.0006 ± 0.0118	0.0026 ± 0.0092
G-7805, 7806	Jul, 1995	Gr. Beta	5.0973 ± 0.1994	5.1127 ± 0.2103	5.1050 ± 0.1449
G-7805, 7806	Jul, 1995	I-131(g)	-0.0048 ± 0.0205	-0.0183 ± 0.0205	-0.0115 ± 0.0145
G-7805, 7806	Jul, 1995	K-40	6.0481 ± 0.5610	5.8484 ± 0.5100	5.9483 ± 0.3791
CW-7648, 7649	Jul, 1995	Gr. Beta	6.6883 ± 1.7265	6.7478 ± 1.7419	6.7181 ± 1.2263
CW-7648, 7649	Jul, 1995	Gr. Beta	0.7444 ± 1.2623	0.2325 ± 1.2230	0.4885 ± 0.8788
CW-7648, 7649	Jul, 1995	H-3	-64.4182 ± 97.4643	-70.1870 ± 97.2364	-67.3026 ± 68.8371
WW-7673, 7674	Jul, 1995	Gr. Beta	14.1451 ± 2.2254	14.2212 ± 2.2315	14.1831 ± 1.5757
WW-7673, 7674	Jul, 1995	H-3	15.3145 ± 81.7571	36.3720 ± 82.7373	25.8432 ± 58.1586
MI-7896, 7897	Jul, 1995	Sr-89	0.3508 ± 0.9697	0.1856 ± 0.8702	0.2682 ± 0.6514
MI-7896, 7897	Jul, 1995	Sr-90	1.7110 ± 0.4271	1.2961 ± 0.3929	1.5036 ± 0.2902
WW-7967, 7968	Jul, 1995	H-3	109.4679 ± 84.6270	70.8322 ± 82.8444	90.1500 ± 59.2134
MI-7922, 7923	Jul, 1995	Co-60	0.5680 ± 3.1300	-1.0500 ± 4.4600	-0.2410 ± 2.7244
MI-7922, 7923	Jul, 1995	Cs-137	1.2100 ± 2.8600	-0.5040 ± 3.4200	0.3530 ± 2.2291
MI-7922, 7923	Jul, 1995	I-131	0.0502 ± 0.1932	0.0416 ± 0.2336	0.0459 ± 0.1516
LW-7944, 7945	Jul, 1995	Co-60	0.0830 ± 2.2000	1.3000 ± 1.8900	0.6915 ± 1.4502
LW-7944, 7945	Jul, 1995	Cs-137	0.6400 ± 2.2200	-1.3800 ± 1.8200	-0.3700 ± 1.4353
LW-7944, 7945	Jul, 1995	Gr. Beta	4.1332 ± 0.9251	3.9971 ± 0.9393	4.0652 ± 0.6592
SW-8704, 8705	Jul, 1995	Co-60	0.1830 ± 2.4900	0.9840 ± 1.7900	0.5835 ± 1.5333
SW-8704, 8705	Jul, 1995	Cs-137	0.2640 ± 3.4500	-0.6630 ± 1.9100	-0.1995 ± 1.9717
WW-8196, 8197	Jul, 1995	H-3	51.4226 ± 87.9172	176.0234 ± 93.3551	113.7230 ± 64.1183
SWU-8318, 8319	Jul, 1995	Gr. Beta	1.9584 ± 0.4714	1.9228 ± 0.4731	1.9406 ± 0.3340
SWU-8318, 8319	Jul, 1995	H-3	102.7030 ± 103.6806	35.5141 ± 101.1620	69.1086 ± 72.4283
SWU-8318, 8319	Jul, 1995	K-40	93.2530 ± 39.7000	99.7420 ± 49.1000	96.4975 ± 31.5710
SP-8540 8541	Jul, 1995	Gr. Alpha	5.1903 ± 1.3072	3.8567 ± 1.0701	4.5235 ± 0.8447
SP-8540, 8541	Jul, 1995	Sr-89	1,443.0886 ± 42.0809	1,419.4750 ± 35.3491	1,431.2818 ± 27.4789
SP-8540, 8541	Jul, 1995	Sr-90	15.7496 ± 3.7553	19.4328 ± 4.1309	17.5912 ± 2.7914

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
VE-8090, 8091	Jul, 1995	Gr. Beta	2.3819 ± 0.0781	2.3059 ± 0.0779	2.3439 ± 0.0552
VE-8090, 8091	Jul, 1995	K-40	2.8208 ± 0.1170	2.7639 ± 0.1330	2.7924 ± 0.0886
SW-8175, 8176	Jul, 1995	Gr. Alpha	0.5000 ± 0.6000	0.6583 ± 0.8198	0.5791 ± 0.5080
SW-8175, 8176	Jul, 1995	Gr. Beta	0.8100 ± 1.1000	0.8265 ± 1.0847	0.8182 ± 0.7724
SW-8175, 8176	Jul, 1995	K-40	89.8150 ± 23.8000	67.3590 ± 39.3000	78.5870 ± 22.9724
SW-8251, 8252	Jul, 1995	H-3	86.7952 ± 78.8856	43.9921 ± 76.9259	65.3937 ± 55.0921
SW-8606, 8607	Jul, 1995	Co-60	0.1320 ± 1.7100	-0.2180 ± 2.6000	-0.0430 ± 1.5560
SW 8606, 8607	Jul, 1995	Cs-137	-1.0400 ± 2.0400	-0.6580 ± 2.2400	-0.8490 ± 1.5149
G - 8272, 8273	Aug, 1995	K-40	6.7487 ± 0.6490	6.6636 ± 0.9730	6.7062 ± 0.5848
G - 8272, 8273	Aug, 1995	Sr-89	0.0014 ± 0.0091	-0.0007 ± 0.0029	0.0004 ± 0.0048
G - 8272, 8273	Aug, 1995	Sr-90	0.0053 ± 0.0029	0.0016 ± 0.0012	0.0034 ± 0.0016
G-8272, 8273	Aug, 1995	Gr. Beta	6.2167 ± 0.2594	5.9667 ± 0.2551	6.0917 ± 0.1819
MI-8293, 8294	Aug, 1995	I-131	-0.1058 ± 0.1908	0.0093 ± 0.2009	-0.0483 ± 0.1385
MI-8389, 8390	Aug, 1995	I-131	-0.0127 ± 0.1267	0.1153 ± 0.1318	0.0513 ± 0.0914
MI-8389, 8390	Aug, 1995	K-40	1,543.8000 ± 120.0000	1,369.6000 ± 162.0000	1,456.7000 ± 100.8018
MI-8413, 8414	Aug, 1995	Co-60	0.2940 ± 3.1400	-2.3500 ± 5.2200	-1.0280 ± 3.0458
MI-8413, 8414	Aug, 1995	Cs-137	-0.7370 ± 2.8900	-1.3600 ± 3.3100	-1.0485 ± 2.1971
MI-8413, 8414	Aug, 1995	I-131	0.1142 ± 0.2124	0.0598 ± 0.2344	0.0870 ± 0.1581
LW-8440, 8441	Aug, 1995	Co-60	0.1030 ± 2.3800	1.0300 ± 1.8100	0.5665 ± 1.4950
LW-8440, 8441	Aug, 1995	Cs-137	0.7760 ± 1.9900	-0.3890 ± 2.0500	0.1935 ± 1.4285
LW-8440, 8441	Aug, 1995	Gr. Beta	3.3064 ± 1.1388	4.6623 ± 1.2154	3.9844 ± 0.8327
WW-8518, 8519	Aug, 1995	Co-60	1.4700 ± 3.1400	-1.8100 ± 2.9800	-0.1700 ± 2.1645
WW-8518, 8519	Aug, 1995	Cs-137	1.7100 ± 2.8700	0.4430 ± 2.7700	1.0765 ± 1.9944
WW-8518, 8519	Aug, 1995	H-3	10.6795 ± 74.0469	-19.5791 ± 72.5777	-4.4498 ± 51.8422
VE-8564, 8565	Aug, 1995	Co-60	0.0053 ± 0.0122	0.0054 ± 0.0128	0.0053 ± 0.0088
VE-8564, 8565	Aug, 1995	Cs-137	0.0038 ± 0.0093	-0.0003 ± 0.0082	0.0018 ± 0.0062
MI-8585, 8586	Aug, 1995	Co-60	-0.4810 ± 4.0600	1.8800 ± 2.5900	0.6995 ± 2.4079
MI-8585, 8586	Aug, 1995	Cs-134	0.1220 ± 3.5000	0.9370 ± 2.2700	0.5295 ± 2.0858
MI-8585, 8586	Aug, 1995	Cs-137	1.7700 ± 3.6400	0.2160 ± 2.0700	0.9930 ± 2.0937
MI-8585, 8586	Aug, 1995	I-131	-0.2002 ± 0.2079	0.0732 ± 0.1900	-0.0635 ± 0.1408
MI-8585, 8586	Aug, 1995	I-131(g)	0.1360 ± 9.0300	2.4300 ± 6.8100	1.2830 ± 5.6550
MI-8585, 8586	Aug, 1995	K-40	1,454.6000 ± 150.0000	1,478.2000 ± 104.0000	1,466.4000 ± 91.2634
MI-8585, 8586	Aug, 1995	Sr-89	0.1158 ± 1.1111	-0.0833 ± 0.9491	0.0162 ± 0.7306
MI-8585, 8586	Aug, 1995	Sr-90	1.9078 ± 0.4296	1.6029 ± 0.3807	1.7553 ± 0.2870
MI-8674, 8675	Aug, 1995	Co-60	-0.7910 ± 3.2300	0.4890 ± 3.3400	-0.1510 ± 2.3232
MI-8674, 8675	Aug, 1995	Cs-137	0.7690 ± 2.4300	0.4160 ± 2.4000	0.5925 ± 1.7077

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-8674, 8675	Aug, 1995	I-131	0.1471 ± 0.2525	-0.0869 ± 0.2167	0.0301 ± 0.1664
SW-8648, 8649	Aug, 1995	H-3	35.5546 ± 75.1429	21.3328 ± 74.4670	28.4437 ± 52.8956
F-8754, 8755	Aug, 1995	Co-60	0.0009 ± 0.0110	0.0031 ± 0.0106	0.0020 ± 0.0076
F-8754, 8755	Aug, 1995	Cs-134	-0.0026 ± 0.0090	-0.0022 ± 0.0087	-0.0024 ± 0.0063
F-8754, 8755	Aug, 1995	Cs-137	0.0528 ± 0.0207	0.0563 ± 0.0171	0.0546 ± 0.0134
F-8754, 8755	Aug, 1995	Gr. Beta	13.1178 ± 0.3041	12.6488 ± 0.2780	12.8833 ± 0.2060
F-8754, 8755	Aug, 1995	I-131(g)	0.0026 ± 0.0139	0.0013 ± 0.0121	0.0019 ± 0.0092
F-8754, 8755	Aug, 1995	K-40	2.8119 ± 0.3670	3.2605 ± 0.3670	3.0362 ± 0.2595
VE-8946, 8947	Aug, 1995	Gr. Alpha	0.2000 ± 0.0800	0.2018 ± 0.0786	0.2009 ± 0.0561
VE-8946, 8947	Aug, 1995	Gr. Beta	4.3000 ± 0.1500	4.3179 ± 0.1511	4.3089 ± 0.1065
VE-8946, 8947	Aug, 1995	K-40	3.9615 ± 0.2670	4.0418 ± 0.3300	4.0017 ± 0.2122
VE - 8802, 8803	Aug, 1995	Sr-89	-0.0001 ± 0.0018	-0.0004 ± 0.0022	-0.0002 ± 0.0014
VE - 8802, 8803	Aug, 1995	Sr-90	0.0011 ± 0.0006	0.0013 ± 0.0007	0.0012 ± 0.0005
VE-8802, 8803	Aug, 1995	K-40	2.3052 ± 0.2360	2.3039 ± 0.3070	2.3046 ± 0.1936
MI-8845, 8846	Aug, 1995	I-131	0.0098 ± 0.1785	0.0835 ± 0.1740	0.0467 ± 0.1246
CW-8873, 8874	Aug, 1995	Gr. Beta	1.8586 ± 1.3992	4.2592 ± 1.5511	3.0589 ± 1.0445
CW-8873, 8874	Aug, 1995	Gr. Beta	-0.6043 ± 1.1348	-0.0465 ± 1.1799	-0.3254 ± 0.8185
MI-8902, 8903	Aug, 1995	I-131	-0.0387 ± 0.2325	0.1320 ± 0.3198	0.0466 ± 0.1977
VE-9035, 9036	Aug, 1995	K-40	2.1934 ± 0.2790	2.3847 ± 0.3380	2.2891 ± 0.2191
SW-9056, 9057	Aug, 1995	H-3	140.7425 ± 79.5937	55.2281 ± 75.6687	97.9853 ± 54.9111
MI-9113, 9114	Aug, 1995	I-131	0.2205 ± 0.3289	0.2711 ± 0.2835	0.2458 ± 0.2171
LW-9079, 9080	Aug, 1995	Co-60	0.8410 ± 2.8400	0.1630 ± 2.9900	0.5020 ± 2.0619
LW-9079, 9080	Aug, 1995	Cs-137	0.7700 ± 2.7700	-0.5330 ± 2.6700	0.1185 ± 1.9237
LW-9079, 9080	Aug, 1995	Gr. Beta	2.7566 ± 0.8607	2.6961 ± 0.8549	2.7264 ± 0.6065
SW-9183, 9184	Aug, 1995	Co-60	-0.3280 ± 3.0000	2.2200 ± 4.0400	0.9460 ± 2.5160
SW-9183, 9184	Aug, 1995	Cs-137	0.8200 ± 3.4400	0.2580 ± 4.3700	0.5390 ± 2.7808
SWU-9162, 9163	Aug, 1995	Gr. Beta	2.5000 ± 0.5000	2.5094 ± 0.5480	2.5047 ± 0.3709
SWU-9162, 9163	Aug, 1995	H-3	152.0000 ± 88.0000	157.4341 ± 83.7394	154.7170 ± 60.7377
WW-9276, 9277	Aug, 1995	H-3	1,636.0299 ± 130.9904	1,680.8118 ± 132.2095	1,658.4209 ± 93.0562
VE-9210, 9211	Aug, 1995	Gr. Beta	4.1000 ± 0.2000	4.0920 ± 0.1675	4.0960 ± 0.1304
VE-9210, 9211	Aug, 1995	K-40	4.6449 ± 0.1090	4.6203 ± 0.1150	4.6326 ± 0.0792
DW-9371, 9372	Aug, 1995	Gr. Beta	4.9900 ± 1.1960	4.5327 ± 1.1679	4.7613 ± 0.8358
DW-9371, 9372	Aug, 1995	I-131	0.1312 ± 0.2093	0.1381 ± 0.1961	0.1346 ± 0.1434
MI-9297, 9298	Aug, 1995	I-131	0.0434 ± 0.1996	0.0510 ± 0.2134	0.0472 ± 0.1461
MI-9297, 9298	Aug, 1995	K-40	1,727.8000 ± 180.0000	1,602.7000 ± 172.0000	1,665.2500 ± 124.4829
WW-9252, 9253	Sep, 1995	H-3	530.8948 ± 98.7085	538.0449 ± 98.9671	534.4698 ± 69.8889

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI-9327, 9328	Sep, 1995	I-131	0.1442 ± 0.1680	0.0972 ± 0.1575	0.1207 ± 0.1151
WW-9396, 9397	Sep, 1995	Co-60	2.0600 ± 2.4700	0.6870 ± 2.9500	1.3735 ± 1.9238
WW-9396, 9397	Sep, 1995	Cs-137	2.6700 ± 2.7300	0.7790 ± 2.5900	1.7245 ± 1.8816
WW-9396, 9397	Sep, 1995	Gr. Beta	0.6947 ± 1.3597	1.7640 ± 1.3095	1.2293 ± 0.9439
WW-9396, 9397	Sep, 1995	H-3	14.9063 ± 76.6085	48.8927 ± 78.1795	31.8995 ± 54.7287
SW - 10075, 10076	Sep, 1995	H-3	262.0954 ± 87.9940	265.6857 ± 88.1404	263.8905 ± 62.2730
SW - 10075, 10076	Sep, 1995	Sr-89	-1.1140 ± 0.9865	0.7627 ± 0.9505	-0.1756 ± 0.6849
SW - 10075, 10076	Sep, 1995	Sr-90	0.6409 ± 0.2630	0.3425 ± 0.2113	0.4917 ± 0.1687
MI-9350, 9351	Sep, 1995	I-131	-0.0990 ± 0.1565	0.0745 ± 0.1636	-0.0123 ± 0.1133
MI-9350, 9351	Sep, 1995	K-40	1,335.3000 ± 163.0000	1,521.4000 ± 179.0000	1,428.3500 ± 121.0475
MI - 9463, 9464	Sep, 1995	I-131	0.1059 ± 0.1889	0.0550 ± 0.1695	0.0804 ± 0.1269
MI-9463, 9464	Sep, 1995	K-40	1,814.9000 ± 139.0000	1,743.1000 ± 180.0000	1,779.0000 ± 113.7113
BS - 9710, 9711	Sep, 1995	K-40	8.3415 ± 0.3890	8.7853 ± 0.3190	8.5634 ± 0.2515
CW - 9486, 9487	Sep, 1995	Gr. Beta	0.3695 ± 1.1728	-0.8827 ± 1.4122	-0.2566 ± 0.9179
CW-9486, 9487	Sep, 1995	Gr. Beta	3.1540 ± 1.5156	3.4306 ± 1.5908	3.2923 ± 1.0986
SO - 9562, 9563	Sep, 1995	Cs-137	0.4189 ± 0.0216	0.4786 ± 0.0443	0.4488 ± 0.0246
SO - 9562, 9563	Sep, 1995	K-40	14.9730 ± 0.4070	15.6780 ± 0.6540	15.3255 ± 0.3852
VE-9515, 9516	Sep, 1995	Co-60	-0.0018 ± 0.0107	-0.0046 ± 0.0074	-0.0032 ± 0.0065
VE-9515, 9516	Sep, 1995	Cs-137	-0.0003 ± 0.0080	-0.0017 ± 0.0071	-0.0010 ± 0.0054
MI-9611, 9612	Sep, 1995	I-131	0.1395 ± 0.2011	0.0905 ± 0.2020	0.1150 ± 0.1425
MI-9611, 9612	Sep, 1995	K-40	1,463.6000 ± 163.0000	1,381.6000 ± 117.0000	1,422.6000 ± 100.3220
SW-9583, 9584	Sep, 1995	H-3	191.7867 ± 84.3836	59.5611 ± 78.5845	125.6739 ± 57.6544
LW - 9632, 9633	Sep, 1995	Gr. Beta	4.9397 ± 0.8738	4.1679 ± 0.7956	4.5538 ± 0.5909
LW-9632, 9633	Sep, 1995	Co-60	0.2420 ± 2.5400	0.6900 ± 1.8800	0.4660 ± 1.5800
LW-9632, 9633	Sep, 1995	Cs-134	-0.9850 ± 2.5000	0.2670 ± 2.3000	-0.3590 ± 1.6985
LW-9632, 9633	Sep, 1995	Cs-137	0.7330 ± 2.7300	1.9600 ± 2.0000	1.3465 ± 1.6921
LW-9632, 9633	Sep, 1995	I-131	-0.0233 ± 0.1923	0.1754 ± 0.2465	0.0761 ± 0.1563
LW-9632, 9633	Sep, 1995	I-131(g)	-1.2000 ± 7.8600	-1.7800 ± 6.9200	-1.4900 ± 5.2361
LW-9632, 9633	Sep, 1995	K-40	73.2000 ± 35.1000	84.4840 ± 38.9000	78.8420 ± 26.1974
MI-9677, 9678	Sep, 1995	I-131	0.1492 ± 0.1575	-0.0782 ± 0.2124	0.0355 ± 0.1322
MI-9677, 9678	Sep, 1995	K-40	1,579.6000 ± 149.0000	1,387.5000 ± 150.0000	1,483.5500 ± 105.7131
CW-9654, 9655	Sep, 1995	Gr. Beta	3.8956 ± 1.4702	4.0324 ± 1.4561	3.9640 ± 1.0346
CW-9654, 9655	Sep, 1995	Gr. Beta	-0.4258 ± 1.0721	0.1637 ± 1.0778	-0.1311 ± 0.7601
MI-9758, 9759	Sep, 1995	Co-60	0.0531 ± 2.3000	-1.0600 ± 5.6200	-0.5035 ± 3.0362
MI-9758, 9759	Sep, 1995	Cs-137	0.1530 ± 2.1000	3.3300 ± 4.1300	1.7415 ± 2.3166
MI-9758, 9759	Sep, 1995	I-131	0.0357 ± 0.1262	0.1303 ± 0.1374	0.0830 ± 0.0933

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
VE-9781, 9782	Sep, 1995	K-40	3.6858 ± 0.3040	3.8621 ± 0.3830	3.7740 ± 0.2445
WW - 9917, 9918	Sep, 1995	Gr. Alpha	1.0000 ± 1.2000	0.1895 ± 1.3470	0.5948 ± 0.9020
WW - 9917, 9918	Sep, 1995	Gr. Beta	2.0000 ± 1.6000	1.4626 ± 1.5372	1.7313 ± 1.1094
WW - 9917, 9918	Sep, 1995	K-40	61.5990 ± 27.2000	55.4580 ± 30.1000	58.5285 ± 20.2845
SWU - 10054, 10055	Sep, 1995	Gr. Beta	2.8699 ± 0.6506	2.9815 ± 0.6273	2.9257 ± 0.4519
SWU - 10054, 10055	Sep, 1995	H-3	272.2258 ± 86.5578	186.8216 ± 82.9725	229.5237 ± 59.9514
CW-9848, 9849	Sep, 1995	Gr. Beta	10.0958 ± 2.0529	10.6091 ± 2.0035	10.3525 ± 1.4343
CW-9848, 9849	Sep, 1995	Gr. Beta	0.6483 ± 1.1139	0.0874 ± 1.0548	0.3678 ± 0.7670
CW-9848, 9849	Sep, 1995	H-3	2.3592 ± 75.6414	-2.9490 ± 75.3926	-0.2949 ± 53.3987
MI-9873, 9874	Sep, 1995	I-131	0.1317 ± 0.1666	0.2502 ± 0.2503	0.1909 ± 0.1503
SW - 10174, 10175	Sep, 1995	Co-60	-0.2100 ± 1.9300	0.0995 ± 3.2500	-0.0553 ± 1.8899
SW - 10174, 10175	Sep, 1995	Cs-137	-0.0756 ± 2.9100	-0.1070 ± 2.8500	-0.0913 ± 2.0366
WW-9988, 9989	Sep, 1995	H-3	126.1391 ± 81.1795	18.2725 ± 76.3358	72.2058 ± 55.7164
SWT - 10033, 10034	Sep, 1995	Gr. Beta	1.7710 ± 0.4680	1.9280 ± 0.4610	1.8495 ± 0.3285
P-10216, 10217	Sep, 1995	H-3	76.4356 ± 78.6697	74.6580 ± 78.5893	75.5468 ± 55.5994
SW-10261, 10262	Sep, 1995	H-3	279.1447 ± 88.4376	300.6173 ± 89.3023	289.8810 ± 62.8413
VE - 10012, 10013	Sep, 1995	Gr. Beta	5.6577 ± 0.3023	5.0000 ± 0.4415	5.3288 ± 0.2675
MI-10120, 10121	Sep, 1995	I-131	0.1055 ± 0.1292	0.0027 ± 0.1196	0.0541 ± 0.0880
MI-10120, 10121	Sep, 1995	K-40	1,446.6000 ± 163.0000	1,300.9000 ± 145.0000	1,373.7500 ± 109.0802
SW-10195, 10196	Sep, 1995	H-3	-19.5632 ± 74.6957	103.1512 ± 80.3270	41.7940 ± 54.8450
CW - 10240, 10241	Sep, 1995	Gr. Beta	2.7919 ± 1.4430	3.6514 ± 1.5144	3.2216 ± 1.0459
CW - 10240, 10241	Sep, 1995	Gr. Beta	0.5909 ± 1.1545	2.4180 ± 1.3151	1.5045 ± 0.8750
SW-10150, 10151	Sep, 1995	H-3	119.1208 ± 81.0078	129.7884 ± 81.4747	124.4546 ± 57.4465
SW - 10282, 10283	Oct, 1995	Gr. Beta	2.1771 ± 0.4791	1.8939 ± 0.4661	2.0355 ± 0.3342
WW - 10349, 10350	Oct, 1995	H-3	64.9002 ± 80.1767	47.3596 ± 79.4055	56.1299 ± 56.4215
WW-10349, 10350	Oct, 1995	Co-60	0.0850 ± 1.2400	1.4900 ± 2.0900	0.7875 ± 1.2151
WW-10349, 10350	Oct, 1995	Cs-137	0.7540 ± 1.1500	0.0703 ± 2.2400	0.4122 ± 1.2590
VE-10370, 10371	Oct, 1995	K-40	3.3443 ± 0.4620	3.2897 ± 0.4770	3.3170 ± 0.3320
F-10491, 10492	Oct, 1995	Co-60	-0.0087 ± 0.0120	0.0051 ± 0.0078	-0.0018 ± 0.0072
F-10491, 10492	Oct, 1995	Cs-137	-0.0053 ± 0.0105	-0.0009 ± 0.0056	-0.0031 ± 0.0059
AP - 10752, 10753	Oct, 1995	Co-60	-0.0006 ± 0.0006	-0.0007 ± 0.0005	-0.0007 ± 0.0004
AP - 10752, 10753	Oct, 1995	Cs-134	0.0007 ± 0.0004	0.0003 ± 0.0007	0.0005 ± 0.0004
AP - 10752, 10753	Oct, 1995	Cs-137	-0.0004 ± 0.0005	0.0000 ± 0.0005	-0.0002 ± 0.0003
AP - 10752, 10753	Oct, 1995	I-131(g)	0.0016 ± 0.0034	-0.0005 ± 0.0047	0.0005 ± 0.0029
AP - 10752, 10753	Oct, 1995	K-40	0.0344 ± 0.0103	0.0436 ± 0.0113	0.0390 ± 0.0076
AP - 11141, 11142	Oct, 1995	Co-60	0.0001 ± 0.0004	0.0002 ± 0.0002	0.0001 ± 0.0002

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
AP - 11141, 11142	Oct, 1995	Cs-137	0.0000 ± 0.0003	0.0003 ± 0.0004	0.0002 ± 0.0002
MI - 10324, 10325	Oct, 1995	Co-60	0.3420 ± 2.2000	-1.0200 ± 3.2000	-0.3390 ± 1.9416
MI - 10324, 10325	Oct, 1995	Cs-134	1.4400 ± 1.9300	-1.0300 ± 2.5800	0.2050 ± 1.6110
MI - 10324, 10325	Oct, 1995	Cs-137	0.3320 ± 2.0800	0.9930 ± 2.5600	0.6625 ± 1.6492
MI - 10324, 10325	Oct, 1995	I-131	0.1255 ± 0.1379	0.0629 ± 0.2061	0.0942 ± 0.1240
MI - 10324, 10325	Oct, 1995	I-131(g)	-0.8920 ± 2.6900	1.1700 ± 3.2900	0.1390 ± 2.1249
MI - 10324, 10325	Oct, 1995	K-40	1,440.7000 ± 88.9000	1,432.5000 ± 120.0000	1,436.6000 ± 74.6713
MI - 10324, 10325	Oct, 1995	Sr-89	-0.4912 ± 0.9456	-1.3268 ± 0.8823	-0.9090 ± 0.6466
MI - 10324, 10325	Oct, 1995	Sr-90	1.6952 ± 0.3864	1.7252 ± 0.3803	1.7102 ± 0.2711
WWU-10392, 10393	Oct, 1995	I-131	0.0442 ± 0.1674	0.0223 ± 0.1698	0.0333 ± 0.1192
F-10470, 10471	Oct, 1995	Co-60	0.0049 ± 0.0063	0.0037 ± 0.0052	0.0043 ± 0.0041
F-10470, 10471	Oct, 1995	Cs-137	0.0003 ± 0.0050	0.0020 ± 0.0037	0.0011 ± 0.0031
SW - 10413, 10414	Oct, 1995	H-3	41.1376 ± 77.3777	62.2941 ± 78.3358	51.7159 ± 55.0541
WW-10437, 10438	Oct, 1995	H-3	81.6446 ± 78.1486	-10.6493 ± 73.8374	35.4977 ± 53.7568
MI - 10512, 10513	Oct, 1995	I-131	0.0662 ± 0.1335	0.0996 ± 0.1517	0.0829 ± 0.1010
SO - 10577, 10578	Oct, 1995	Co-60	0.0033 ± 0.0117	0.0032 ± 0.0142	0.0033 ± 0.0092
SO - 10577, 10578	Oct, 1995	Cs-134	0.0204 ± 0.0110	0.0277 ± 0.0128	0.0241 ± 0.0084
SO - 10577, 10578	Oct, 1995	Cs-137	0.1528 ± 0.0249	0.1687 ± 0.0241	0.1608 ± 0.0173
SO - 10577, 10578	Oct, 1995	Gr. Beta	18.4120 ± 3.0080	20.0560 ± 3.0020	19.2340 ± 2.1249
SO - 10577, 10578	Oct, 1995	K-40	19.0300 ± 0.5920	18.4690 ± 0.6160	18.7495 ± 0.4272
MI - 10598, 10599	Oct, 1995	I-131	0.0233 ± 0.1528	-0.1143 ± 0.1290	-0.0455 ± 0.1000
F - 10666, 10667	Oct, 1995	Co-60	-0.0011 ± 0.0149	0.0022 ± 0.0134	0.0005 ± 0.0100
F - 10666, 10667	Oct, 1995	Cs-137	0.0062 ± 0.0109	0.0088 ± 0.0102	0.0075 ± 0.0075
WW - 11206, 11207	Oct, 1995	H-3	144.1480 ± 82.0522	298.7082 ± 106.1128	221.4281 ± 67.0681
F - 10687, 10688	Oct, 1995	Co-60	-0.0056 ± 0.0092	0.0052 ± 0.0111	-0.0002 ± 0.0072
F - 10687, 10688	Oct, 1995	Cs-137	0.0051 ± 0.0081	-0.0007 ± 0.0102	0.0022 ± 0.0065
MI - 10710, 10711	Oct, 1995	I-131	-0.0702 ± 0.1760	0.0060 ± 0.1746	-0.0321 ± 0.1240
WW - 10797, 10798	Oct, 1995	H-3	255.7388 ± 88.0244	190.9283 ± 85.4061	223.3336 ± 61.3239
F - 10882, 10883	Oct, 1995	K-40	2.4355 ± 0.2770	2.3158 ± 0.4530	2.3757 ± 0.2655
CW - 10826, 10827	Oct, 1995	Gr. Beta	1.9841 ± 1.3273	1.1082 ± 1.2551	1.5461 ± 0.9134
SWU - 10923, 10924	Oct, 1995	Gr. Beta	2.3790 ± 0.5752	2.7204 ± 0.5897	2.5497 ± 0.4119
SWU - 10923, 10924	Oct, 1995	H-3	908.5097 ± 108.7289	878.3050 ± 107.7372	893.4074 ± 76.5331
F - 10969, 10970	Oct, 1995	Cs-137	0.0391 ± 0.0173	0.0589 ± 0.0281	0.0490 ± 0.0165
F - 10969, 10970	Oct, 1995	Gr. Beta	2.3088 ± 0.0750	2.1970 ± 0.0758	2.2529 ± 0.0533
F - 10969, 10970	Oct, 1995	K-40	2.1279 ± 0.3500	1.8750 ± 0.4010	2.0015 ± 0.2661
CW - 10773, 10774	Oct, 1995	Gr. Beta	8.4208 ± 1.8580	9.9060 ± 2.0352	9.1634 ± 1.3779

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
CW - 10773, 10774	Oct, 1995	Gr. Beta	-0.2668 ± 1.0986	0.8745 ± 1.1142	0.3039 ± 0.7824
CW - 10773, 10774	Oct, 1995	H-3	51.6603 ± 77.7745	67.5106 ± 78.4831	59.5854 ± 55.2481
CW - 10858, 10859	Oct, 1995	Gr. Beta	3.8461 ± 1.5209	5.5313 ± 1.6346	4.6887 ± 1.1163
CW - 10858, 10859	Oct, 1995	Gr. Beta	0.1646 ± 1.1055	-0.2698 ± 1.0572	-0.0526 ± 0.7648
BS - 11056, 11057	Oct, 1995	Cs-137	0.3037 ± 0.0214	0.3183 ± 0.0167	0.3110 ± 0.0136
BS - 11056, 11057	Oct, 1995	K-40	18.5050 ± 0.4060	18.2890 ± 0.3850	18.3970 ± 0.2798
F - 11078, 11079	Oct, 1995	K-40	2.6694 ± 0.1700	2.7062 ± 0.1140	2.6878 ± 0.1023
CW - 11261, 11262	Oct, 1995	Gr. Beta	3.4182 ± 1.5101	3.8050 ± 1.4573	3.6116 ± 1.0493
CW - 11261, 11262	Oct, 1995	Gr. Beta	-0.9607 ± 0.9909	-0.1199 ± 1.1241	-0.5403 ± 0.7492
MI - 11162, 11163	Oct, 1995	I-131	0.2163 ± 0.2174	0.0872 ± 0.2019	0.1517 ± 0.1483
LW - 11185, 11186	Oct, 1995	Co-60	0.2560 ± 2.0000	0.0639 ± 3.9000	0.1600 ± 2.1915
LW - 11185, 11186	Oct, 1995	Cs-137	0.9690 ± 1.9600	1.3800 ± 3.2600	1.1745 ± 1.9019
LW - 11185, 11186	Oct, 1995	Gr. Beta	7.9276 ± 1.3579	6.7150 ± 1.2839	7.3213 ± 0.9344
MI - 11284, 11285	Oct, 1995	I-131	0.1805 ± 0.2626	0.1868 ± 0.2352	0.1837 ± 0.1763
MI - 11284, 11285	Oct, 1995	K-40	1,759.4000 ± 182.0000	1,581.9000 ± 164.0000	1,670.6500 ± 122.4949
DW - 11565, 11566	Oct, 1995	Gr. Beta	2.3856 ± 0.4715	2.6159 ± 0.5003	2.5008 ± 0.3437
DW - 11565, 11566	Oct, 1995	I-131	-0.1047 ± 0.3170	0.1835 ± 0.2833	0.0394 ± 0.2126
SW - 11309, 11310	Oct, 1995	Gr. Alpha	0.5829 ± 0.5262	1.1580 ± 0.6097	0.8705 ± 0.4027
SW - 11309, 11310	Oct, 1995	Gr. Beta	3.1323 ± 0.6596	2.5628 ± 0.6351	2.8475 ± 0.4579
MI - 11351, 11352	Oct, 1995	I-131	0.0319 ± 0.2455	0.0097 ± 0.2195	0.0208 ± 0.1647
MI - 11351, 11352	Oct, 1995	K-40	1,492.6000 ± 166.0000	1,431.8000 ± 160.0000	1,462.2000 ± 115.2779
SW - 11330, 11331	Oct, 1995	H-3	83.4709 ± 77.8239	106.3960 ± 78.8560	94.9335 ± 55.3959
MI - 11407, 11408	Oct, 1995	I-131	-0.1272 ± 0.1871	0.1059 ± 0.1876	-0.0106 ± 0.1325
MI - 11433, 11434	Nov, 1995	I-131	-0.0607 ± 0.1789	0.1317 ± 0.1462	0.0355 ± 0.1155
MI - 11433, 11434	Nov, 1995	K-40	1,446.0000 ± 167.0000	1,450.8000 ± 119.0000	1,448.4000 ± 102.5305
MI - 11433, 11434	Nov, 1995	Sr-89	-0.0542 ± 1.2560	-0.0961 ± 1.1700	-0.0752 ± 0.8583
MI - 11433, 11434	Nov, 1995	Sr-90	1.9383 ± 0.4889	1.8933 ± 0.4555	1.9158 ± 0.3341
BS - 11453, 11454	Nov, 1995	Gr. Beta	8.3022 ± 1.4598	7.0981 ± 1.3963	7.7002 ± 1.0100
BS - 11453, 11454	Nov, 1995	K-40	13.4130 ± 0.6950	14.3840 ± 1.0200	13.8985 ± 0.6171
MI - 11476, 11477	Nov, 1995	I-131	-0.0379 ± 0.1804	0.0878 ± 0.2013	0.0250 ± 0.1352
MI - 11476, 11477	Nov, 1995	K-40	1,425.6000 ± 155.0000	1,379.5000 ± 93.1000	1,402.5500 ± 90.4055
MI - 11476, 11477	Nov, 1995	Sr-89	0.1529 ± 1.5801	0.6656 ± 1.1518	0.4092 ± 0.9777
MI - 11476, 11477	Nov, 1995	Sr-90	1.5845 ± 0.6297	0.7492 ± 0.4308	1.1668 ± 0.3815
WW - 11657, 11658	Nov, 1995	Gr. Beta	0.3756 ± 0.4690	0.4697 ± 0.5060	0.4226 ± 0.3450
WW - 11657, 11658	Nov, 1995	H-3	110.2042 ± 79.0344	172.1940 ± 81.6909	141.1991 ± 56.8327
SW - 11519, 11520	Nov, 1995	H-3	86.0705 ± 77.9529	10.3285 ± 74.5326	48.1995 ± 53.9253

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
WW - 11837, 11838	Nov, 1995	Co-60	0.6630 ± 1.5100	0.0996 ± 3.2500	0.3813 ± 1.7918
WW - 11837, 11838	Nov, 1995	Cs-137	0.0882 ± 1.6800	-0.5360 ± 2.9800	-0.2239 ± 1.7105
MI - 11588, 11589	Nov, 1995	K-40	1,282.9000 ± 161.0000	1,390.4000 ± 145.0000	1,336.6500 ± 108.3351
MI - 11611, 11612	Nov, 1995	I-131	0.0368 ± 0.2007	0.1136 ± 0.2056	0.0752 ± 0.1437
MI - 11611, 11612	Nov, 1995	K-40	1,368.1000 ± 112.0000	1,291.1000 ± 158.0000	1,329.6000 ± 96.8349
CW - 11678, 11679	Nov, 1995	Gr. Beta	2.6565 ± 1.5123	2.0599 ± 1.3520	2.3582 ± 1.0143
MI - 11786, 11787	Nov, 1995	I-131	0.0519 ± 0.1914	-0.0830 ± 0.1791	-0.0156 ± 0.1311
MI - 11786, 11787	Nov, 1995	K-40	1,493.0000 ± 100.0000	1,459.1000 ± 170.0000	1,476.0500 ± 98.6154
CW - 11865, 11866	Nov, 1995	Gr. Beta	1.9803 ± 1.4093	1.1128 ± 1.3439	1.5466 ± 0.9737
LW - 11926, 11927	Nov, 1995	Co-60	-0.6990 ± 2.1700	-1.3700 ± 3.3200	-1.0345 ± 1.9831
LW - 11926, 11927	Nov, 1995	Cs-137	1.3600 ± 2.0100	1.6800 ± 2.6800	1.5200 ± 1.6750
LW - 11926, 11927	Nov, 1995	Gr. Beta	3.5794 ± 0.9059	4.2705 ± 0.9513	3.9250 ± 0.6568
PW - 12451, 12452	Nov, 1995	Co-60	0.1370 ± 1.6200	1.5900 ± 2.0000	0.8635 ± 1.2869
PW - 12451, 12452	Nov, 1995	Cs-137	-1.0900 ± 1.7200	0.8750 ± 2.5000	-0.1075 ± 1.5173
WW - 12659, 12660	Nov, 1995	H-3	10,454.1364 ± 283.5019	10,315.0095 ± 281.7458	10,384.5729 ± 199.8462
G - 12184, 12185	Nov, 1995	K-40	7.1257 ± 0.4820	7.2496 ± 0.5540	7.1877 ± 0.3672
DW - 12229, 12230	Nov, 1995	Gr. Beta	1.4868 ± 0.4353	1.5192 ± 0.4562	1.5030 ± 0.3153
DW - 12229, 12230	Nov, 1995	H-3	48.3898 ± 76.5630	70.8565 ± 77.5707	59.6232 ± 54.4957
SO - 12430, 12431	Dec, 1995	Cs-137	0.2060 ± 0.0696	0.1746 ± 0.0629	0.1903 ± 0.0469
SO - 12430, 12431	Dec, 1995	Gr. Alpha	15.7026 ± 4.4545	10.9075 ± 4.1010	13.3051 ± 3.0274
SO - 12430, 12431	Dec, 1995	Gr. Beta	22.3778 ± 2.8536	23.0769 ± 2.9630	22.7273 ± 2.0568
SO - 12430, 12431	Dec, 1995	K-40	16.6990 ± 1.3000	17.6620 ± 1.3500	17.1805 ± 0.9371
LW - 12152, 12153	Dec, 1995	Co-60	1.4300 ± 3.3200	3.3800 ± 2.1000	2.4050 ± 1.9642
LW - 12152, 12153	Dec, 1995	Cs-137	-0.1400 ± 3.1900	0.3640 ± 2.8500	0.1120 ± 2.1388
LW - 12152, 12153	Dec, 1995	Gr. Beta	5.1509 ± 1.3079	4.8804 ± 1.1924	5.0157 ± 0.8849
MI - 12250, 12251	Dec, 1995	I-131	0.1190 ± 0.1943	0.1981 ± 0.2178	0.1586 ± 0.1460
MI - 12250, 12251	Dec, 1995	K-40	1,470.3000 ± 163.0000	1,386.6000 ± 126.0000	1,428.4500 ± 103.0109
WW - 12298, 12299	Dec, 1995	Co-60	0.4210 ± 2.3800	0.1770 ± 4.0900	0.2990 ± 2.3660
WW - 12298, 12299	Dec, 1995	Cs-137	0.1580 ± 2.0500	1.5200 ± 2.7700	0.8390 ± 1.7230
WW - 12298, 12299	Dec, 1995	H-3	42.7622 ± 77.9643	99.7786 ± 80.5282	71.2704 ± 56.0429
LW - 12380, 12381	Dec, 1995	Co-60	1.2700 ± 2.4400	2.2300 ± 2.2300	1.7500 ± 1.6528
LW - 12380, 12381	Dec, 1995	Cs-134	0.5120 ± 2.1300	1.9500 ± 2.2200	1.2310 ± 1.5383
LW - 12380, 12381	Dec, 1995	Cs-137	0.8060 ± 2.5100	1.2200 ± 2.4400	1.0130 ± 1.7503
LW - 12380, 12381	Dec, 1995	I-131	0.0861 ± 0.1243	0.1222 ± 0.2055	0.1041 ± 0.1201
LW - 12380, 12381	Dec, 1995	I-131(g)	-7.3600 ± 13.8000	4.7100 ± 13.4000	-1.3250 ± 9.6177
LW - 12380, 12381	Dec, 1995	K-40	129.0000 ± 41.2000	133.0000 ± 34.7000	131.0000 ± 26.9329

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

Lab Codes[b]	Sample Date	Analysis	Concentration in pCi/L[a] First Result	Second Result	Averaged Result
MI - 12325, 12326	Dec, 1995	I-131	-0.1263 ± 0.2456	0.1598 ± 0.2063	0.0167 ± 0.1604
MI - 12325, 12326	Dec, 1995	K-40	1,409.0000 ± 172.0000	1,438.6000 ± 169.0000	1,423.8000 ± 120.5664
WW - 12347, 12348	Dec, 1995	H-3	77.2534 ± 78.8630	87.6308 ± 79.3168	82.4421 ± 55.9252
F - 12688, 12689	Dec, 1995	Co-60	0.0009 ± 0.0117	0.0011 ± 0.0141	0.0010 ± 0.0092
F - 12688, 12689	Dec, 1995	Cs-134	0.0044 ± 0.0094	-0.0069 ± 0.0138	-0.0013 ± 0.0084
F - 12688, 12689	Dec, 1995	Cs-137	0.0366 ± 0.0179	0.0266 ± 0.0149	0.0316 ± 0.0116
F - 12688, 12689	Dec, 1995	I-131(g)	-0.0050 ± 0.0244	0.0254 ± 0.0422	0.0102 ± 0.0244
F - 12688, 12689	Dec, 1995	K-40	2.4139 ± 0.3400	2.5180 ± 0.3700	2.4660 ± 0.2512
PW - 12945, 12946	Dec, 1995	Co-60	0.2950 ± 2.7700	1.4000 ± 1.9600	0.8475 ± 1.6967
PW - 12945, 12946	Dec, 1995	Cs-137	1.4900 ± 2.5600	0.1240 ± 2.1900	0.8070 ± 1.6845

[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.

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

In cases where the activity is found to be below the lower limit of detection L it is reported as

$$< L$$

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

3.0 Duplicate analyses

3.1 Individual results: $x_1 \pm s_1$
$x_1 \pm s_2$

Reported result: $x \pm s$

where $x = (1/2)(x_1 \pm x_2)$

$$s = (1/2)\sqrt{s_1^2 + s_2^2}$$

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 $x \geq L$;

$< L$ 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:

$$\bar{x} = \frac{1}{n} \Sigma x$$

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

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

4.3 If all of the 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 greater than or equal to 5, the figure is dropped and the last retained figure is raised by 1 As an example, 11.446 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 Fedeeral 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 — Docket No. 50-346
Location of Facility Ottawa, Ohio (County, State) — Reporting Period January - December 1995

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Airborne particulates (pCi/m^3)	GB 520	0.005	0.020 (310/312) (0.008-0.045)	T-1,2 Both locations had identical means	0.021 (104/104) (0.008-0.045)	0.020 (208/208) (0.008-0.046)	0
	Sr-89 40	0.0011	<LLD	-	-	<LLD	0
	Sr-90 40	0.0006	<LLD	T-2, Site Boundary, 0.9 mi E	0.0024 (1/4)	0.0024 (1/16)	0
	GS 40						
	Be-7	0.015	0.080 (24/24) (0.052-0.109)	T-1, Site Boundary, 0.6 mi ENE	0.090 (4/4) (0.073-0.108)	0.084 (16/16) (0.055-0.099)	0
	K-40	0.048	<LLD	-	-	<LLD	0
	Nb-95	0.0019	<LLD	-	-	<LLD	0
	Zr-95	0.0037	<LLD	-	-	<LLD	0
	Ru-103	0.0021	<LLD	-	-	<LLD	0
	Ru-106	0.015	<LLD	-	-	<LLD	0
	Cs-134	0.0013	<LLD	-	-	<LLD	0
	Cs-137	0.0015	<LLD	-	-	<LLD	0
	Ce-141	0.0030	<LLD	-	-	<LLD	0
	Ce-144	0.0070	<LLD	-	-	<LLD	0
Airborne Iodine (pCi/m^3)	I-131 520	0.07[f]	<LLD	-	-	<LLD	0
TLD (Quarterly) (mR/91 days)	Gamma 296	1.0	13.0 (253/253) (7.4-20.2)	T-8, Farm, 2.7 mi WSW	19.1 (4/4) (17.3-20.2)	14.2 (43/43) (8.9-20.4)	0
TLD (Quarterly) (mR/91 days) (Shield)	Gamma 4	1.0	5.0 (4/4) (4.4-5.3)	-	-	None	0
TLD (Annual) (mR/365 days)	Gamma 72	1.0	56.2 (62/62) (35.7-77.1)	T-8, Farm, 2.7 mi WSW	77.1 (1/1)	62.4 (10/10) (47.1-74.7)	0
TLD (Annual) (mR/365 days) (Shield)	Gamma 1	1.0	23.0 (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 Reporting Period January - December 1995
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean Location[d]	Location with Highest Quarterly Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Milk (pCi/L)	I-131 12	0.5	none	-	-	<LLD	0
	Sr-89 12	0.8	none	-	-	<LLD	0
	Sr-90 12	0.5	none	T-24, Sandusky, 21.0 mi SE	1.2 (12/12) (0.7-2.8)	1.2 (12/12) (0.7-2.8)	0
	GS 12						
	K-40	100	none	T-24, Sandusky, 21.0 mi SE	1450 (12/12) (1370-1610)	1450 (12/12) (1370-1610)	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	0.89 (12/12) (0.78-1.04)	0.89 (12/12) (0.78-1.04)	0
(g/L)	K (stable) 12	0.1	none	T-24, Sandusky, 21.0 mi SE	1.68 (12/12) (1.58-1.86)	1.68 (12/12) (1.58-1.86)	0
(pCi/g)	Sr-90/Ca 12	0.36	none	T-24, Sandusky, 21.0 mi SE	1.37 (12/12) (0.75-3.29)	1.37 (12/12) (0.75-3.29)	0
(pCi/g)	Cs-137/K 12	6.31	none	-	-	<LLD	0
Ground Water (pCi/L)	GB (TR) 12	2.0	3.6 (8/8) (2.9-5.6)	T-27, Crane Creek, 5.3 mi WNW	6.8 (2/4) (4.6-8.9)	5.3 (2/4) (4.6-6.0)	0
	H-3 12	330	<LLD	-	-	<LLD	0
	Sr-89 12	1.2	<LLD	-	-	<LLD	0
	Sr-90 12	0.8	<LLD	-	-	<LLD	0
	GS 12						
	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
Location of Facility Ottawa, Ohio (County, State)
Docket No. 50-346
Reporting Period January - December 1995

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean Location[d]	Location with Highest Quarterly Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Edible Meat (pCi/g wet)	GS 2						
	K-40	0.1	2.77 (1/1)	T-34, Onsite Roving Location	2.81 (1/1)	2.81 (1/1)	0
	Cs-137	0.017	<LLD	-	-	<LLD	0
Fruits and Vegetables (pCi/g wet)	Sr-89 4	0.0065	<LLD	-	-	<LLD	0
	Sr-90 4	0.0007	<LLD	T-173, Firelands, 20.0 mi. SE	0.0036 (1/1)	0.0036 (1/2)	0
	I-131 4	0.021	<LLD	-	-	<LLD	0
	GS 4						
	K-40	0.50	1.10 (2/2) (1.09-1.11)	T-173, Firelands, 20.0 mi. SE	3.04 (1/1)	2.12 (2/2) (1.20-3.04)	0
	Nb-95	0.013	<LLD	-	-	<LLD	0
	Zr-95	0.023	<LLD	-	-	<LLD	0
	Cs-137	0.012	<LLD	-	-	<LLD	0
	Ce-141	0.027	<LLD	-	-	<LLD	0
	Ce-144	0.072	<LLD	-	-	<LLD	0
Broad Leaf Vegetation (pCi/g wet)	Sr-89 13	0.0067	<LLD	-	-	<LLD	0
	Sr-90 13	0.0030	0.0043 (3/9) (0.0033-0.0056)	T-19, Hemminger Farm, 0.68 mi. W	0.0043 (3/5) (0.0033-0.0056)	<LLD	0
	I-131 13	0.021	<LLD	-	-	<LLD	0
	GS 13						
	K-40	0.1	3.17 (9/9) (1.78-5.72)	T-19, Hemminger Farm, 0.68 mi. W	3.60 (5/5) (2.30-5.72)	2.14 (4/4) (1.90-2.49)	0
	Nb-95	0.014	<LLD	-	-	<LLD	0
	Zr-95	0.033	<LLD	-	-	<LLD	0
	Cs-137	0.015	<LLD	-	-	<LLD	0
	Ce-141	0.022	<LLD	-	-	<LLD	0
	Ce-144	0.12	<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 1995

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean Location[d]	Location with Highest Quarterly Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Animal Wildlife Feed (pCi/g wet)	GS 4						
	Be-7	0.072	0.54 (2/2) (0.47-0.62)	T-198, Toussaint Creek 4.0 mi. WSW	0.62 (1/1)	<LLD	0
	K-40	0.1	2.52 (3/3) (01.35-4.68)	T-34, Offsite Roving location, >10 mi.	5.34 (1/1)	5.34 (1/1)	0
	Nb-95	0.017	<LLD	-	-	<LLD	0
	Zr-95	0.051	<LLD	-	-	<LLD	0
	Ru-103	0.021	<LLD	-	-	<LLD	0
	Ru-106	0.18	<LLD	-	-	<LLD	0
	Cs-137	0.024	<LLD	-	-	<LLD	0
	Ce-141	0.057	<LLD	-	-	<LLD	0
	Ce-144	0.13	<LLD	-	-	<LLD	0
Soil (pCi/g dry)	GS 20						
	Be-7	0.95	<LLD			<LLD	0
	K-40	1.0	15.90 (12/12) (1.56-29.20)	T-4, Site Boundary, 0.8 mi S	24.90 (2/2) (20.61-29.20)	21.67 (8/8) (19.08-24.92)	0
	Nb-95	0.21	<LLD	-	-	<LLD	0
	Zr-95	0.18	<LLD	-	-	<LLD	0
	Ru-103	0.12	<LLD	-	-	<LLD	0
	Ru-106	0.48	<LLD	-	-	<LLD	0
	Cs-137	0.064	0.57 (9/12) (0.052-1.35)	T-8, Farm 2.7 mi. WSW	1.09 (2/2) (0.83-1.35)	0.40 (8/8) (0.11-0.86)	0
	Ce-141	0.28	<LLD	-	-	<LLD	0
	Ce-144	0.45	<LLD	-	-	<LLD	0
Treated Surface Water (pCi/L)	GB (TR) 48	1.0	2.0 (24/24) (1.5-2.7)	T-11, Port Clinton Water Treatment Plant, 9.5 mi. SE	2.4 (12/12) (1.9-2.9)	2.1 (24/24) (1.3-2.9)	0
	H-3 16	330	<LLD	-	-	<LLD	0
	Sr-89 16	1.4	<LLD	-	-	<LLD	0
	Sr-90 16	0.6	1.0 (3/8) (0.7-1.6)	T-50, Erie Ind. Park 4.5 mi. SE	1.0 (3/4) (0.7-1.6)	0.8 (3/8) (0.7-0.8)	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 1995

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean Location[d]	Location with Highest Quarterly Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Treated Surface Water (pCi/L) *(continued)*	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-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) 120	1.0	2.6 (72/72) (1.7-5.4)	T-152, Canal Entrance to Maumee Bay S.P. 15.6 mi. WNW	3.7 (6/6) (2.3-5.4)	2.4 (48/48) (1.6-5.3)	0
	H-3 120	330	681 (7/72) (330-1234)	T-131 , Lake Erie, 0.8 mi NE	1064 (2/6) (893-1234)	486 (2/48) (345-628)	0
	Sr-89 20	1.3	<LLD	-	-	<LLD	0
	Sr-90 20	0.9	<LLD	-	-	<LLD	0
	GS 120						
	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 (County, State) — Reporting Period January - December 1995

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Quarterly Mean: Location[d]	Location with Highest Quarterly Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range	Number Non-Routine Results[e]
Fish (pCi/g wet)	GB 6	0.1	3.06 (3/3) (2.59-3.55)	T-35, Lake Erie, > 10 mi. radius	3.34 (3/3) (2.75-3.69)	3.34 (3/3) (2.75-3.69)	0
	GS 6						
	K-40	0.1	3.01 (3/3) (2.59-3.23)	T-35, Lake Erie, > 10 mi. radius.	3.09 (3/3) (2.83-3.37)	3.09 (3/3) (2.83-3.37)	0
	Mn-54	0.019	<LLD	-	-	<LLD	0
	Fe-59	0.078	<LLD	-	-	<LLD	0
	Co-58	0.018	<LLD	-	-	<LLD	0
	Co-60	0.021	<LLD	-	-	<LLD	0
	Zn-65	0.048	<LLD	-	-	<LLD	0
	Cs-134	0.022	<LLD	-	-	<LLD	0
	Cs-137	0.024	<LLD	-	-	<LLD	0
Shoreline Sediments (pCi/g dry)	GS 10						
	K-40	0.1	16.62 (8/8) (12.18-27.09)	T-4P, Site Boundary, 0.8 mi. S	24.75 (2/2) (22.41-27.09)	13.70 (2/2) (13.22-14.18)	0
	Mn-54	0.029	<LLD	-	-	<LLD	0
	Co-58	0.080	<LLD	-	-	<LLD	0
	Co-60	0.049	<LLD	-	-	<LLD	0
	Cs-134	0.11	<LLD	-	-	<LLD	0
	Cs-137	0.048	<LLD	-	-	<LLD	0

[a] GB = gross beta, GS = gamma scan, TR = total residue.
[b] LLD = nominal lower limit of detection based on 4.66 sigma counting error for background sample.
[c] Mean based upon detectable measurements only. 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] One result (<0.08 pCi/m^3) exceeded the required LLD. The LLD was not reached due to low volume.

FOR MORE INFORMATION, WRITE OR CALL:

DAVIS-BESSE NUCLEAR POWER STATION
RADIATION PROTECTION SECTION
5501 NORTH STATE ROUTE 2
OAK HARBOR, OHIO 43449

(419) 321-7310

CENTERIOR ENERGY

TOLEDO EDISON