BWXT of Ohio, Inc.

a McDermott company

MEMP Environmental Monitoring Plan

September, 2000

BWXT

Manages the Mound Exit Project for the

U.S. Department of Energy (DOE/MEMP)

under contract No. DOE-AC-97OH20044

MEMP Environmental Monitoring Plan

September 2000

Miamisburg Environmental Management Project (MEMP)

B. M. Farmer, J. F. Gavin, S. L. Howard,
R. P. Paulick, J. K. Puckett, J. S. Stapleton

September 2000

Prepared by the
Environmental Safeguards and Compliance
BWXT of Ohio, Inc.
P.O. Box 3000
Miamisburg, OH 45343-3000

for the
U.S. Department of Energy
Under Contract
No. DOE-AC-97OH20044

MEMP
Environmental Monitoring Plan

Approved: ____
Susan Brechbill, Manger Date
Ohio Field Office

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Environmental Monitoring Plan (EMP) is to describe the environmental monitoring and surveillance programs in place at Miamisburg Environmental Management Project (MEMP). The Plan is required by DOE Order 5400.1 (DOE, 1990). The programs described in the EMP are required by the DOE 5400 Order series and by the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE, 1991), referred to as the *Regulatory Guide* throughout this Plan.

1.2 Scope

This Plan sets forth the requirements for the routine environmental monitoring and surveillance programs established by MEMP. Program elements in the following key areas are discussed:

- effluent monitoring,
- meteorological monitoring,
- environmental surveillance,
- laboratory procedures,
- quality assurance,
- dose calculations, and
- report preparation and disposition.

Groundwater surveillance is the subject of a separate plan, the *Groundwater Monitoring Program and Groundwater Protection Management Program Plan* (DOE, 1997).

1.3 Facility Description

Miamisburg Environmental Management Project (MEMP), formally known as the Mound Plant, is a federally-owned facility operated by BWXT of Ohio, Inc. for the U. S. Department of Energy (DOE). This site's historical mission included production, development, and research in support of DOE's weapon and energy related programs. As a result of the November 22, 1993, DOE decision to phase-out the defense mission at the Mound Plant MEMP's defense-related programs have been transferred to other sites within the DOE complex. Current Miamisburg Environmental Management Project (MEMP) objectives include environmental restoration and the transition of the site for reuse as a commercial facility. As a result of recent economic development activities by the Miamisburg Mound Community Improvement Corporation (MMCIC), several private businesses have initiated operations at the Plant.

Figure 1-1. Locations of the Mound Plant and Surrounding Communities

Figure 1-2. Location of the Mound Plant

The MEMP, formally named after the Miamisburg Indian Mound adjacent to the site, comprises 99 buildings on 124 hectares (306 acres) of land in Miamisburg, Ohio, approximately 16 km (10 mi) southwest of Dayton (Figures 1-1 and 1-2). The Great Miami River, which flows through the city of Miamisburg, dominates the landscape of the five-county region surrounding MEMP. The river valley is highly industrialized. The rest of the region is predominately farmland dotted with residential areas, small communities and light industry.

The site topography is shown in Figure 1-5 located at the end of this Chapter. MEMP site elevations vary from 216 m to 268 m (700 ft to 900 ft) above sea level; most of the Plant is above 244 m (800 ft). No building in which radioactive material is processed is located below an elevation of 241 m (790 ft). The typical non-flood stage of the Great Miami River is 208 m (682 ft). The highest flood-water levels that can be reasonably postulated for the Great Miami River basin (100-year storm event) would result in flooding to 216 m (710 ft), which is approximately the lowest elevation at the site. No buildings at MEMP or known contamination areas are located in a floodplain or in areas considered wetlands.

MEMP was added to the National Priorities List (NPL) in 1989 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Preliminary CERCLA assessment of contamination at MEMP identified approximately 125 locations of actual or suspected releases. These locations were grouped into "Operable Units" (OUs) based on waste type and/or geographical proximity. Originally, MEMP established nine OUs. As CERCLA activities at MEMP progressed, changes to the number and composition of the OUs were warranted. In 1995, the MEMP CERCLA program was reorganized to streamline and speed up the cleanup process. The new concept termed "MOUND 2000" is a DOE proposal to accelerate the cleanup of the plant site in order to release the land for economic development much sooner than originally planned. The MOUND 2000 process consolidates the nine former OUs into three OUs. Additionally, MOUND 2000 breaks the site down into approximately ten parcels containing more than 400 individual "Potential Release Sites" (PRSs). The MOUND 2000 process starts with a core team, one member from DOE, the U. S. Environmental Protection Agency (U. S. EPA), and Ohio Environmental Protection Agency (OEPA) to review the status of each PRS. DOE assembles a concise information package on the PRS that is the basis for decision making. The core team then decides to either (1) clean-up the site, (2) make no further assessment, or (3) obtain additional information before going further. The core team decision is then presented to the MEMP stakeholders. If there is a consensus to clean-up the PRS, the MOUND 2000 process calls for a Removal Action (a rapid response to the clean-up). The MOUND 2000 process thus allows for accelerated clean-up of the site by focusing on PRSs and streamlining decision making.

1.4 Program Objectives

Key objectives of the environmental programs described in this Plan are to:

- demonstrate compliance with applicable environmental federal, state, and local regulations and DOE Orders,
- provide information to the public on plant releases and potential impacts of routine facility operation,
- obtain data to assess the consequences of unplanned releases,
- obtain data to identify long-term trends, and to
- support environmental management decisions.

1.5 Program Implementation

It is the responsibility of the Environmental Safeguards & Compliance (ES&C) of BWXT of Ohio, Inc. (Figure 1-3) to secure approval of this Plan. Approval is granted by the Manager, Ohio Field Office, DOE. ES&C is also charged with fully implementing the Plan. Plan implementation occurs under the direct supervision of the Office of Environmental Management of DOE/MEMP (Figure 1-4).

DOE Order 5400.1 requires that the EMP be reviewed each year and updated every three years. The ES&C group of BWXT of Ohio, Inc. is responsible for conducting the review and producing the updates.

1.6 Independent Oversight

Environmental monitoring programs described in this Plan are subject to oversight by the OEPA via the Agreement-in-Principle (AIP). The AIP, signed in 1993 by DOE and the State of Ohio, provides OEPA with a mechanism for (1) evaluating MEMP environmental data and activities, and (2) developing independent and split sampling programs.

OEPA activities associated with the AIP are routinely reported to stakeholders. These reports include comparisons of OEPA sampling results with MEMP results. The OEPA Office of Federal Facilities Oversight is the appropriate contact for more information about this program.

Figure 1-3. Organizational Elements of BWXT of Ohio, Inc. MEMP

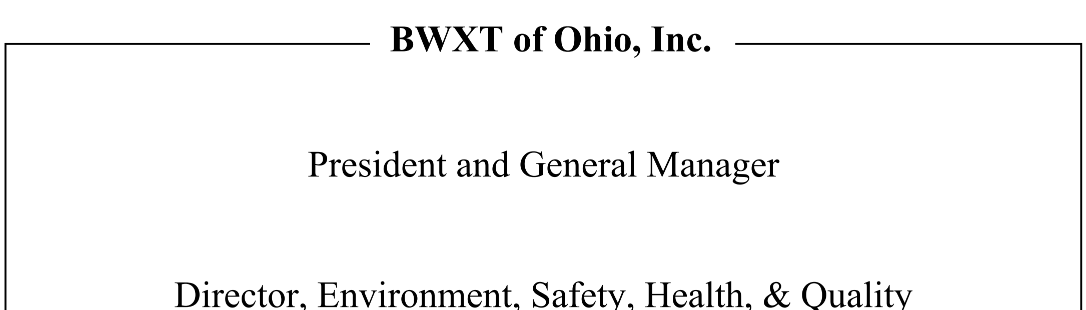


Figure 1-4. Organizational Elements of the DOE Miamisburg Environmental Management Project

U.S. Departments of Energy
Miamisburg Environmental Management Project

Director

Associate Director
Office of Environmental Management

Team Leader, Environmental Stewardship

1.7 Overview

The preceding sections described the general objectives of the *Environmental Monitoring Plan for Mound.* The goals of the EMP are established based on the requirements of DOE Order 5400.1 (DOE, 1990) and the *Regulatory Guide* (DOE, 1991).

Chapter 2 of this Plan describes MEMP's programs for monitoring airborne and liquid effluents (releases). The meteorological monitoring programs, and their roles in dispersion modeling for chronic and acute releases, are discussed in Chapter 3. Chapter 4 details the environmental surveillance programs in place at MEMP. Chapters 5 and 6 of the Plan describe dose calculations and reporting requirements, respectively. A table summarizing MEMP's effluent monitoring and environmental surveillance programs is provided in Appendix A.

Procedures for the collection and analysis of effluent and environmental samples are incorporated by reference into this Plan. Compliance with this Plan requires that only the most current version of procedures and methods be applied.

Figure 1-5. Mound Topographical Map

2.0 EFFLUENT MONITORING

2.1 Introduction

Effluents produced by MEMP consist of process exhaust air (stacks), process wastewater, sewage water, and storm water. MEMP's effluent monitoring program is designed to show compliance with state, Department of Energy (DOE), and federal EPA standards, and to provide early warning of atypical conditions so that timely corrective actions can be undertaken.

For different periods of time throughout the history of operations at the MEMP, various radionuclides have been used. These nuclides include actinium-227, americium-241, bismuth-207, bismuth-210, cesium-137, cobalt-60, hydrogen-3, plutonium-237, plutonium-238, plutonium-239, plutonium-240, polonium-210, protactinium-231, radium-226, radon-222, strontium-90, thorium-228, thorium-229, thorium-230, thorium-232, uranium-233, uranium-234, uranium-235, and uranium-238. In this chapter, MEMP monitoring programs for radionuclides released to air and water effluents are described. Discussions of sampling programs for nonradionuclides released to air and water effluents then follow.

2.2 Radionuclides Released to Air

The development of an airborne effluent radionuclide monitoring program is required by DOE Orders 5400.1 (DOE, 1990) and 5400.5 (DOE, 1993a), and the *Regulatory Guide* (DOE, 1991). In addition to DOE requirements, the U. S. EPA has established regulations (40 CFR 61, Subpart H) governing airborne radionuclide emissions from DOE facilities. These regulations are referred to as radionuclide National Emission Standards for Hazardous Air Pollutants (NESHAPs). MEMP is also subject to a NESHAPs Federal Facility Compliance Agreement (FFCA) between U. S. EPA and DOE. This agreement establishes milestones for actions which will be taken to bring MEMP's effluent sampling and monitoring program into full compliance with 40 CFR 61, Subpart H.

2.2.1 Rationale

MEMP has 12 stacks and bubbler units continuously monitoring primary exhaust air stacks and building vents for various radionuclides. The radionuclides monitored at each stack are identified in Table 2-1. The general location of each stack is shown in Figure 2-1. Sample collection and analysis are limited to those radionuclides currently in use, and those which could still exist in ductwork or other equipment. If all traces of a particular radionuclide have been removed, or if the quantity or form of a particular radionuclide can not reasonably be expected to lead to a significant air emission, then it is not included in the stack monitoring program. Many smaller facilities at MEMP fall into this category. Examples include analytical laboratories and some production areas where administrative limits governing facility operations limit the quantity of radionuclides present at a given time.

Table 2-1. Radionuclides Monitored at Mound Plant Stacks

Building Stack	Radionuclide(s)
HEFS	Tritium, Pu-238, Pu-239, 240, U-233, 234, U-238, Th-230
NCDPF	Tritium
SW-1CN	Tritium, Pu-238, Pu-239, 240, U-233, 234, U-238, Th-230
22	Tritium
23	Tritium
CWPF	Tritium, Pu-238, Pu-239, 240, U-233, 234, U-238
T-West	Tritium, Pu-238, Pu-239, 240, U-233, 234, U-238
T-East	Tritium
HH Building	Tritium
WDA(a)	Tritium, Pu-238, Pu-239, 240, U-233, 234, U-238
WD SS	Pu-238, Pu-239, 240
SM/PP	Pu-238, Pu-239, 240, U-233, 234, U-238

(a) The WD Low Risk and WD High Risk stacks were combined into the new WDA stack in 1996.

2.2.2 Stack Monitoring Equipment

The following section describes the instruments used at MEMP to sample and monitor exhaust air continuously for gaseous and particulate radionuclides. An alarm for elevated radionuclide emissions is in operation at each of the stacks to provide timely warning and to signal the need for corrective action.

Collection and Monitoring of Particulate Samples

As shown in Table 2-1, seven stacks are monitored for particulate (plutonium, thorium and uranium). Samples of particulate emissions are collected by off-line alpha sampler/monitor systems. Alpha sampler/monitor systems consist primarily of sample transport lines, alpha continuous air monitors (CAMs), and vacuum pumps. The alpha CAMs perform the dual function of collecting particulate on an internal filter and monitoring the presence of alpha particles on the surface of the filter. Counts from the real time monitor are compared to a set point in the instrument's microprocessor. If the set point is exceeded a audible and visual alarm is triggered.

The vacuum pumps draw a sample of the effluent at a rate of 20 to 80 L/min to collect particulate, which would contain the isotopes of concern. The filters used to trap the particles are 47 mm in diameter. The alarm set points are based on as low as reasonably achievable (ALARA) principles

Figure 2-1. Locations of the Radiological Stacks

Bubblers. As shown in Table 2-1, ten stacks and building vents are monitored for tritium. These stacks are continuously sampled by instrumentation consisting of an ethylene glycol bubbler train, a heated palladium catalyst, a vacuum pump, and a sample mass flow controller. They are described in Technical Manual 80030, Operation 2119. The bubbler train consists of six 20-mL Packard liquid scintillation vials, each filled with 10 mL of ethylene glycol.

The effluent sample passes in series through the first three vials (A, B, C) which trap essentially all of the tritium oxide. The sample then passes through the heated palladium catalyst which oxidizes greater than 99% of the elemental tritium into tritium oxide. By directing the catalyzed sample in series through the final three glycol vials (D, E, F), the newly created oxides are also trapped. The sample then exits the instrument after passing through a control valve and pump. This sampling technique effectively differentiates between tritium oxide and elemental tritium, which is important because the radiotoxicity of tritium oxide is orders of magnitude larger than that of elemental tritium. Bubblers make it possible to detect tritium concentrations as low as $1x10^{-11}$µCi/mL. The sampling flow rate for the bubbler train is controlled at 150 cc/min. The palladium catalyst temperature is maintained at 475^{o}C.

Tritium Monitors. The bubbler assemblies described above provide an excellent means of determining very low tritium concentrations in stack effluents as well as differentiating between elemental tritium and tritium oxide. The bubblers, however, do not provide real-time release data. For real-time monitoring purposes, ionization chambers are used; they provide instant measurements of tritium concentrations, and have audible alarms to indicate increases in tritium emissions.

The chambers are used to monitor continuously rooms, gloveboxes, ducts and stacks which have the potential to release tritium. The unit used for most of the stacks is a 2-liter ion chamber. The range is 0 to 20,000 µCi/m^3 with a resolution of 1 µCi/m^3. Alarm levels are set at 15 to 400 µCi/m^3 depending on the stack. The sample flow rates through the ion chambers are set manually, and range from 4 to 11 L/min depending on location. Sample air is continuously pulled through the ion chamber by an external vacuum pump.

2.2.3 Sample Collection and Analysis

MEMP monitors nine primary stacks continuously for radiological effluents. MEMP is required by 40 CFR 61, Subpart H and the DOE Regulatory Guide to continuously sample point sources that could result in doses greater than 0.1 mrem/year to the most exposed member of the public. Stacks which have potential doses below 0.1 mrem/year require periodic measurements to verify low emissions. More detailed criteria for airborne effluent radionuclide monitoring are listed in Table 2-2.

Table 2-2. Criteria for Radiological Emission Monitoring

Calculated Maximum Dose from Emissions in a Year to Members of the Public: Minimum Emission Monitoring Criteria

EDE $\geq$ 1 mrem

1) Continuously monitor emission points that could contribute 0.1 mrem/year
2) Identify radionuclides that contribute 10% of the dose
3) Determine accuracy of results
4) Conduct annual environmental survey

<u>or</u> monitor at the receptor:

1) Obtain prior approval from U. S. EPA
2) Continuously sample air at receptor
3) Collect and measure radionuclides contributing 1 mrem
4) Establish sample density sufficient to estimate dose to critical receptor

0.1 mrem $\leq$ EDE < 1 mrem

1) Continuously monitor emission points that could contribute 0.1 mrem/year
2) Identify radionuclides that contribute 10% or more of the dose
3) Conduct confirmatory effluent monitoring at emission points
4) Conduct periodic environmental surveys

EDE < 0.1 mrem

1) Collect periodic confirmatory measurements
2) Establish monitoring requirement based upon estimated emissions without pollution control equipment
3) Conduct periodic environmental surveys

Source: DOE Regulatory Guide (DOE, 1991).

Particulates. Particulate samples are collected weekly. Sample collection procedures are described in technical manual MD-80042, *Air Monitoring Procedures Manual*, Operation 3010, <u>Operation of the Eberline Alpha CAM</u> and Operation 3015, <u>Operation of the Eberline Alpha 6 CAM</u>. Both of these procedures are incorporated by reference into this plan.

Weekly accumulated alpha activity from the particulate sample filters is counted and reported monthly. An analysis of a composite sample is performed monthly. The following operations are specific analytical procedures used by MEMP personnel for airborne radionuclide particulate samples. All are part of MD-80030, *Environmental Analytical Procedures*, and are incorporated by reference into this plan.

Operation 0220, Gross Alpha Activity in Environmental Samples is a screening technique using 2π gas flow proportional counting instrumentation.

Operation 9282, Isotopic Analyses of Stack Air Filters used for the analysis of air filters for plutonium, thorium, and uranium. Filters are spiked with the appropriate tracers and wet ashed using nitric and hydrochloric acids. Following wet ashing, the samples are placed in a muffle furnace and heated to remove organic matter. The wet ash process is repeated and followed by selective anion exchange separation. After isotopic separation the samples are electrodeposited and analyzed by alpha spectroscopy (Operation 9317, Environmental Monitoring Alpha Spectroscopy Method).

Tritium. Tritium samples are collected weekly. Sample collection procedures are described in technical manual MD-80042, *Air Monitoring Procedures Manual*, Operation 5040, Operation of the Tritium Bubbler. This procedure is incorporated by reference into this plan.

Bubbler vials, A, B, and C, of the tritium oxide collectors and vials D, E, and F of the elemental tritium collectors are collected weekly. Vials A and D are analyzed weekly. Vials B, C, E, and F are composited for monthly analyses. During events that could significantly increase emissions at a source, MEMP performs laboratory analyses as soon as reasonably possible on effluent samples from the affected area(s).

The following analytical procedure for air effluent tritium is incorporated by reference into this Plan. Operation 2119, Tritium Gas and Tritiated Water in Stack Effluent, describes the vial lab analysis procedure. The analytical procedure consists of mixing an aliquot of the glycol from the bubbler with scintillation cocktail and counting the mixture in a liquid scintillation spectrometer.

2.2.4 Planned Improvements for Stack Monitor Systems

The MEMP modified and rebuilt the WDA, T-West, and SM/PP radionuclide stack monitors/samplers. These changes were completed December 1997. The modifications included installation of isokinetic sampling equipment, stack and sample line mass flow meters, field calibration ports, and an auto-dialer alarm system. The design of the project addressed applicable U. S. EPA regulations as well as DOE Orders. The remaining stack systems were not included in these upgrades because their potential emissions fall below the U. S. EPA threshold of 0.1 mrem/year, and the monitoring systems are adequate.

The upgrading project also addressed many quality assurance/quality control items such as the writing of operating and maintenance procedures, the purchase of spare parts and calibration equipment, and the training of operators. The project was the responsibility of and completed by the BWXT of Ohio, Inc. ES&C group. This project was a focal point of the NESHAPs FFCA which was negotiated with the U. S. EPA and terminated December 1998.

2.3 Radionuclides Released to Surface Water

MEMP has the potential to discharge low levels of radionuclides to water as well as to air. Since there are no wastewater discharges which could reasonably be expected to contain high levels of radioactive materials, real-time monitors with alarms are not necessary for any of MEMP's liquid effluent streams. However, an extensive program of effluent and surface water sampling has been in place at the facility for many years.

DOE Orders 5400.1 (DOE, 1990), 5400.5 (DOE, 1993a), and the DOE Regulatory Guide (DOE, 1991) provide concentration guidelines for radionuclides to minimize public and environmental radiation doses. The DOE has also set standards regarding radionuclide dose limits to the public, and established guidelines for effluent monitoring programs. These requirements help ensure that effluents from DOE facilities have minimal impact on human health and the environment.

2.3.1 Radionuclides in Liquid Effluents

Mound Plant Environmental Safeguards and Compliance personnel sample effluent water for radionuclides at thirteen locations as shown on Figure 2-2. Four of these locations (5002, 5601, 5602, and 5003) are outfalls where effluent exits the facility boundary prior to entering the Great Miami River. In addition, a network of arterials which discharge to three of the primary outfalls, are sampled when sufficient flow is present. Five are storm sewers, and four are sanitary sewers leading to the wastewater treatment plant (WWTP), i.e. 5601. Storm sewer arterials leading to 5002 include SMPI and SMPE and arterials with a "T-_" or directional designations; sanitary sewer arterials are designated by "D-_."

2.3.2 Rationale

The historical and current radionuclides used in operations at MEMP were identified in Section 2.2. Generally, water effluents are analyzed for the same radionuclide contaminants as are the stack effluents. Table 2-3 summarizes the routine radiological monitoring of onsite liquid effluents at Mound.

Table 2-3. Radionuclide Sampling and Analysis of Liquid Effluents

Location	Collection Frequency	Analysis
5601 (SDE)	Daily	Gross alpha and tritium are analyzed each 5602 day. Concentrations of Pu-238, Pu-239,240, U-233/234, U-238 and Th-228, Th-230, and Th-232 are evaluated based on bi-weekly composite samples.
(STA-1)	Daily	
5002 (STA-2)	Daily	
5003	Daily	
D-3	Weekly	Gross alpha & tritium
D-4	Weekly	Gross alpha & tritium
D-5	Weekly	Gross alpha & tritium
D-6	Weekly	Gross alpha & tritium
T-6	Weekly	Gross alpha & tritium
T-7	Weekly	Gross alpha & tritium
T-8	Weekly	Gross alpha & tritium
SMPI	Weekly	Gross alpha & tritium
SMPE	Weekly	Gross alpha & tritium
NW-48	Weekly	Gross alpha & tritium

Figure 2-2. Liquid Effluent Sampling Locations for Radionuclides

2.3.3 Liquid Effluent Sampling Equipment

Flow-proportional, 24-hour, composite samples and grab (manual) samples are collected from outfalls 5601, 5602, and 5002. Time-proportional composite samples and grab samples are collected from the arterial effluents and sampling station 5003. Locations 5601, 5602, 5002, and 5003 are also sampled for nonradioactive parameters in accordance with Ohio EPA National Pollutant Discharge Elimination System (NPDES) permit parameters. (The same equipment is used for both programs.) Automatic sampling and flow measurement equipment is described more fully in Section 2.5.1.

2.3.4 Sample Collection and Analysis

At the locations where water effluent exits the plant boundary (Outfalls 5601, 5602, 5002, and sampling station 5003), composite samples are collected daily during the workweek. One collection is a weekend sampling period, the others are 24-hour sampling periods. Samples are analyzed daily during the workweek for tritium and gross alpha. Samples are composited and analyzed bi-weekly for Pu-238, Pu-239/240, U-233/234, U-238, Th-228, Th-230 and Th-232.

Time-proportional composite samples and grab samples are collected from the sanitary, process, and storm sewer arterial samplers leading to the one of the three plant effluent locations. The arterial composite samples and grab samples are collected weekly, or daily if trends are identified, and analyzed for tritium and gross alpha.

Technical Manual MD-80030 describes analytical procedures for all effluent and environmental media including water. The operations on the following pages are the specific procedures for determining radionuclide content in liquid effluent samples; all are incorporated by reference into this EMP. Compliance with this plan requires that only the most current version of procedures and methods be applied.

Operation 9279, Collection of On-Site Arterial Water Samples, describes the sample collection procedure for various onsite arterial water samples.

Operation 0220, Gross Alpha Radioactivity in Water Samples, describes the measurement of gross alpha particle activity in environmental water samples. The method is a specific screening technique for monitoring onsite arterial streams which flow into MEMP's effluents. An aliquot of a water sample is transferred quantitatively to a 1 7/8-inch diameter stainless steel disk. The sample is dried under a heat lamp and then counted for alpha radioactivity in a 2⑥ gas flow proportional counter.

Operation 1272, Plutonium and Thorium Activity in Water Effluent, is used for determining plutonium and thorium concentrations in unfiltered effluents. This procedure is used to analyze volumes of four liters or less. The lower detection limit is approximately 0.02 pCi/L for a one-liter sample. Flow-proportional effluent samples are collected on a daily basis. A calculated aliquot proportional to effluent volume is taken from each sample and combined for bi-weekly analysis. This procedure consists of coprecipitation, anion exchange separation, and electrodeposition, followed by alpha pulse height analysis (Operation 9317, Environmental Monitoring Alpha Spectroscopy Method).

Operation 2261, Liquid Scintillation Analysis of Water Samples, describes the preparation and screening of environmental water samples for tritium and gross alpha analysis using liquid scintillation spectroscopy. The method has a lower detection limit range of approximately 0.2 - 1.2 nCi/L. A 10-mL environmental water sample is pipetted into a 25-mL polyethylene counting vial containing 10-mL of scintillation solution. The sample vials are counted in a liquid scintillation spectrometer with the tritium energy region configured to 0-18.6 keV and an alpha energy region set to 30 - 550 keV.

Operation 3271, Uranium Activity in Water Effluent, is used for determining uranium concentrations in unfiltered effluents of four liters or less volume. The lower detection limit is approximately 0.03

pCi/L for a one-liter sample counted for 1000 minutes. Flow-proportional effluent samples are collected on a daily basis. A calculated aliquot proportional to effluent volume is taken from each sample and combined for a bi-weekly analysis. This procedure consists of coprecipitation, anion exchange separation, and electrodeposition, followed by alpha pulse height analysis (Operation 9317, Environmental Monitoring Alpha Spectroscopy Method).

2.4 Nonradiological Releases to Air

The MEMP releases small quantities of nonradiological constituents into the atmosphere. The releases are governed by OEPA permits and regulations. A nonradiological air monitoring program is not required by the OEPA. Annual emission rates are calculated using a material balance approach. This section describes the nature, quantity and permit status of the primary nonradiological air emissions at the MEMP.

The Clean Air Act (CAA) of 1970, as amended in 1977, gave the U. S. EPA authority to regulate two groups of airborne pollutants: criteria pollutants and hazardous air pollutants. The CAA was again amended in 1990. A key feature of the 1990 amendments is the requirement that major emitters of pollutants obtain comprehensive air permits (Title V). In order to remain under the threshold at which a Title V permit is necessary, MEMP applied for Federally Enforceable State Operating Permits (FESOPs). The FESOPs place limits on annual usage and thus limit the potential air emissions, enabling MEMP to remain below the Title V application emission threshold.

MEMP is also subject to state and regional air pollution regulations. Compliance with State of Ohio regulations requires that all applicable MEMP operations be permitted or otherwise registered. MEMP has thirteen air permits issued by the OEPA. Ten other sources are registered with the Regional Air Pollution Control Agency (RAPCA). In order for a source to be considered for registration status, (1) the source owner must demonstrate compliance with all applicable laws including employment of best available technology, (2) maximum emissions of particulate matter, sulfur dioxide, nitrogen oxides, and organic compounds cannot exceed five tons per year, and (3) the source cannot be subject to U. S. EPA new source performance standards or the National Emission Standards for Hazardous Air Pollutants (NESHAPs). Table 2-4 summarizes non-radiological air emission sources permitted or registered with the OEPA.

To monitor compliance with all state and local reporting requirements, chemical air emission data are collected each year. This information is maintained in a database that is updated each calendar year.

2.5 Nonradiological Releases to Surface Water

The MEMP’s nonradiological constituents in wastewater are regulated by the Clean Water Act (CWA) which is administered by the OEPA through the issuance of a National Pollutant Discharge Elimination System (NPDES) permit. The permit defines discharge limits and sets the requirements for compliance monitoring. MEMP's current permit was modified March 1998, becoming effective on June 1 of 1998. The existing permit remains in effect until March 31, 2002 or when the OEPA issues a renewed permit.

MEMP's modified NPDES permit requires collection and analysis of samples from three onsite locations (called outfalls) that eventually discharge to the Great Miami River. These outfalls are

5601, 5602, and 5002. The permit also places flow-weighted effluent limitations on the combined discharges of Outfalls 5601 and 5602. This is known as the calculated Outfall 5001. NPDES outfalls and sampling locations are shown on Figure 2-3. Outfall 604 is no longer in service and will be removed from the permit at its next modification.

In addition, effluent exits the site through the CERCLA OU1 treatment facility. The OU1 project addresses possible volatile organic compound (VOC) contamination of the aquifer underlying the southwest corner of the Plant. To contain and treat groundwater, a series of extraction wells and an air stripper were installed. Groundwater is continuously pumped from the extraction wells preventing further migration of contamination into the aquifer. The groundwater is passed through an air stripper to reduce VOC concentrations prior to discharge. The OU1 system is monitored for a number of nonradiological parameters as defined by the OEPA Authorization to Discharge (ATD). The ATD became effective on August 1, 1997 and will remain in effect for the duration of the project. The OU1 sampling location has been designated sampling station 5003.

Table 2-4. Air Emission Source Permits

Operation	Permit No.	Valid Through	Pollutant	Limitations
9 Standby Power Diesel Generators	B010 - B017	revisions pending	particulates, CO, NO_x, SO_2, OC	Annual fuel usage limitations (a)
4 SW/R Fumehoods	P012, P014, P015, P028	Permanent registration	OC	P012 0.52 tons/year P014 0.07 tons/year P015 0.07 tons/year P028 none
Building 48	P008	permanent	none	none

		registration		
Underground Line Removal diesel generator	B008	permanent registration	particulates, CO, NO_x, SO_2, OC	3.4 fuel/hr
Gas dispensing facility	G001	permanent registration	OC	None
Open burning (b) (Fire Training)	letter permit	permanent registration	particulates	3 sessions/wk
Powerhouse (a) Boiler 1 and Boiler 2	B001, B006	permanent registration	particulates	5% opacity
Fuel oil storage	T005	2/17/98	OC	0.006 tpy
R/SW HEFS Stack	P030	1/24/01	OC tritium non-tritium	2.4 tpy 1.4×10^{-4} Ci/year 2.7×10^{-6} Ci/year
Roadways & parking lots	F001	Permanent registration	None	None
Crusher	F003	5/29/01	particulates CO NO_x SO_2 OC	0.76 tpy 5.4 tpy 0.36 tpy 0.44 tpy 1.2 tpy

(a) Ohio EPA modification pending.
(b) Inactive
Ci = Curie
CO = carbon monoxide
NO_x = nitrogen oxides
OC = organic compounds
SO_2 = sulfur dioxide
tpy = tons per year
HEFS = high efficiency filtration system

Figure 2-3. Nonradiological Liquid Effluent Sampling Locations

2.5.1 NPDES Sampling Locations and Descriptions

Outfall 5601. Outfall 5601 contains the effluent from MEMP's sanitary sewage treatment plant. Flow-proportional, 24-hour composite samples and periodic grab samples are collected at this outfall. NPDES permit requirements for this location focus on VOCs, biological oxygen demand, total suspended solids, metals, chlorine, pH, ammonia, and fecal coliform.

Outfall 5602. Outfall 5602 includes storm water runoff, groundwater seepage, single-pass cooling water, zeolite softener backwash, and effluent from the radioactive waste disposal/treatment facility. Flow-proportional, 24-hour composite samples and periodic grab samples are collected at this outfall. NPDES permit requirements for this location include chemical oxygen demand, suspended solids, and oil and grease.

Outfall 5002. Outfall 5002 contains softener backwash, cooling tower blowdown, single-pass cooling water, and most of the site's storm water runoff. Flow-proportional, 24-hour composite samples and periodic grab samples are collected at this outfall. NPDES permit requirements for this location focus on suspended solids and pH.

Calculated Outfall 5001. Outfall 5001 represents the combined effluents of 5601 and 5602. These discharges are combined and released to the Great Miami River via a closed pipe. Since sampling the pipe is not practical, MEMP's NPDES permit imposes limits for this outfall based on flow-weighted concentration calculations.

Outfall 5604. Outfall 5604 is an abandoned well located west of the Plant. In the past, MEMP has purged the well to reduce tritium concentrations in groundwater. The purged water is directed to the Miami-Erie Canal. When this activity is performed, Mound's NPDES permit requires that the flow rate and pH be recorded. The well was last pumped in 1991. In 1998, the closed pipe was removed and the electricity was disconnected.

2.5.2 NPDES Monitoring Requirements

MEMP's NPDES permit defines discharge limits and sets the requirements for compliance monitoring of wastewater discharges. The parameters for analysis, sampling frequency, and other NPDES permit specifications are shown in Table 2-5.

2.5.3 OU1 Monitoring Requirements

The OU1 treatment process with effluent designation 5003 was issued an Authorization to Discharge July 11, 1997, which has similar analytical parameters as the NPDES permit. The routine monitoring requirements for sampling station 5003 are shown in Table 2-6.

Table 2-5. NPDES Permit Specifications

NPDES Permit #1IO00005*HD						
Parameter	Discharge Limitations				Measurement Frequency	Sample Type
	Concentration		Mass Loading (kg/day)			
	30 Day	Daily	30 Day	Daily		
OUTFALL 5001 - FLOW-WEIGHTED COMBINATION of 5601 and 5602						
Nickel, Total Recoverable, µg/L	—	—	—	—	1/Month	24 Hour Composite

Zinc, Total Recoverable, µg /L	—	—	—	—	1/Month	24 Hour Composite
Cadmium, Total Recoverable, µg /L	—	—	—	—	1/Month	24 Hour Composite
Lead, Total Recoverable, µg /L	—	—	—	—	1/Month	24 Hour Composite
Chromium, Total Recoverable, µg /L	—	—	—	—	1/Month	24 Hour Composite
Copper, Total Recoverable, µg /L	—	120	—	0.213	1/Month	24 Hour Composite
Flow Rate, MGD	—	—	—	—	Daily	24Hour Total (Calculated)
Cyanide, Free, mg/L	—	—	—	—	1/Month	Grab Calculated Proportions
pH, standard units	—	6.5 - 9.0	—	—	1/2 Weeks	Grab Calculated Proportions

Table 2-5. NPDES permit specifications (continued)

NPDES Permit #1IO00005*HD						
	Discharge Limitations					
Parameter	Concentration 30 Day	Concentration Daily	Mass Loading(kg/day) 30 Day	Mass Loading(kg/day) Daily	Measurement Frequency	Sample Type
OUTFALL 5002 - STORM WATER DISCHARGE						
Residue, Total Nonfilterable	30	45	—	—	1/Week	24 Hr. Composi

(mg/L)						te
Flow Rate, MGD	__	__	__	__	Daily	24 Hr.
pH, standard units	__	6.5.-9.0			1/Week	Grab

Table 2-5. NPDES Permit Specifications (continued)

NPDES Permit #1IO00005*HD						
	Discharge Limitations					
Parameter	Concentration 30 Day	Concentration Daily	Mass Loading (kg/day) 30 Day	Mass Loading (kg/day) Daily	Measurement Frequency	Sample Type
OUTFALL 5601 - SEWAGE TREATMENT PLANT DISCHARGE						
Residue, Total Nonfilterable (mg/L)	15	30	6.8	13.6	2/Week	24 Hr. Comp.
Oil and Grease,	__	__	__	__	1/Quarter	Grab

Total, mg/L						
Nitrogen, Ammonia (NH_3), mg/L	—	—	—	—	1/2 Weeks	24 Hr. Comp.
Nickel, Total Recoverable, µg /L	—	—	—	—	1/Month	24 Hr. Comp.
Zinc, Total Recoverable, µg/L	—	—	—	—	1/Month	24 Hr. Comp.
Cadmium, Total Recoverable, µg/L	—	—	—	—	1/Month	24 Hr. Comp.
Lead, Total Recoverable, µg/L	—	—	—	—	1/Month	24 Hr. Comp.
Chromium, Total Recoverable, µg/L	—	—	—	—	1/Month	24 Hr. Comp.
Copper, Total Recoverable, µg/L	—	—	—	—	1/Month	24 Hr. Comp.
Fecal Coliform , #/100mL	1000	2000	—	—	1/Week (Summer)	Grab
Flow Rate, MGD	—	—	—	—	Daily	24 Hr. Total

(a) Sampling is not required when facility is not normally staffed Summer = May 1 through October 1 Comp. = Composite

Table 2-5. NPDES Permit Specifications (continued)

NPDES Permit #1IO00005*HD						
Parameter	Discharge Limitations				Measurement Frequency	Sample Type
	Concentration 30 Day	Concentration Daily	Loading (kg/day) 30 Day	Loading (kg/day) Daily		
OUTFALL 5601 - TREATMENT PLANT DISCHARGE (cont.)						
Chlorine, Total Residual (Summer), mg/L	—	—	—	—	Daily(a)	Grab

Biochemical Oxygen Demand, Carbonaceous, mg/L	10	15	4.5	6.8	2/Week	24 Hr. Comp.
pH, standard units	—	6.5-9.0	—	—	Daily	Grab
VOCs including methylethyl ketone and acetone	—	—	—	—	1/Quarter	Grab

(a) Sampling is not required when facility is not normally staffed
Summer = May 1 through October 1
Comp. = Composite

Table 2-5. NPDES Permit Specifications (continued)

NPDES Permit #1IO00005*HD						
	Discharge Limitations					
Parameter	Concentration 30 Day	Concentration Daily	Loading (kg/day) 30 Day	Loading (kg/day) Daily	Measurement Frequency	Sample Type
OUTFALL 5602 - SAMPLING STATION						
Chemical Oxygen Demand, mg/L	—	—	—	—	1/Week	24 Hr. Comp.
Residue, Total Nonfilterable, mg/L	30	45	44.3	66.4	1/Week	24 Hr. Comp.

Oil and Grease, Total, mg/L	—	10	—	14.8	1/Month	Grab
Flow Rate, MGD	—	—	—	—	Daily	24 Hr. Total
pH, standard units		6.5.-9.0			1/Week	Grab

Comp. = Composite

Table 2-5. NPDES Permit Specifications (continued)

NPDES Permit #1IO00005*HD						
Parameter	Discharge Limitations				Measurement Frequency	Sample Type
	Concentration 30 Day	Concentration Daily	Loading (kg/day) 30 Day	Loading (kg/day) Daily		
OUTFALL 5604 -MIAMISBURG WELL NO. 2						
Flow Rate, MGD	—	—	—	—	(b)	24 Hr. Estimate
pH, standard units		6.5-9.0			(b)	Grab

(b) Monitoring requirements apply when well is purged

Table 2-6. OU1 - 5003 Authorization to Discharge Monitoring Requirements

Authorization to Discharge (ATD) #1IN90010*AD						
Parameter	Discharge Limitations				Measurement Frequency	Sample Type
	Concentration		Mass Loading (kg/day)			
	30 Day	Daily	30 Day	Daily		
OUTFALL 003 - OU1 Pump and Treat Facility						
Residue, Total Nonfilterable (mg/L)	30	45	24.5	36.8	1/ 2 Weeks	24 Hr. Comp.
Dissolved Sum of Solids, (mg/L)	—	—	—	—	1/ 2 Weeks	24 Hr. Comp
Dissolved Oxygen, (mg/L)	—	—	—	—	1/Week	Grab

Nickel, Total Recoverable, μg/L	—	—	—	—	1/ 2 Weeks	24 Hr. Comp.
Zinc, Total Recoverable, μg/L	—	—	—	—	1/ 2 Weeks	24 Hr. Comp.
Mercury, Total Recoverable, μg/L	0.023	2.2	0.000019	0.0018	1/ Week	24 Hr. Comp.
Lead, Total Recoverable, μg/L	—	—	—	—	1/ 2 Weeks	24 Hr. Comp.
Chromium, Total, (μg/L)	1100	9800	0.900	8.000	1/ Week	24 Hr. Comp.
Copper, Total Recoverable, μg/L	65	120	0.053	0.098	1/ Week	24 Hr. Comp.
Selenium, Total Recoverable, (μg/L)	—	—	—	—	1/Month	24 Hr. Comp.
Silver, Total Recoverable, (μg/L)	—	—	—	—	1/Month	24 Hr. Comp.

Table 2-6. OU1 - 5003 Authorization to Discharge Monitoring Requirements (continued)

ATD #1IN90010*AD						
Parameter	Discharge Limitations				Measurement Frequency	Sample Type
	Concentration 30 Day	Concentration Daily	Mass Loading (kg/day) 30 Day	Mass Loading (kg/day) Daily		
OUTFALL 003 - OU1 Pump and Treat Facility						
Flow Rate (MGD)	—	—	—	—	Daily	24 Hr. Total
pH, standard units)	—	6.5 - 9.0	—	—	1/ Week	Grab
cBOD-5, (mg/L)	—	—	—	—	1/Month	24 Hr. Comp.
1,2-Dichloroethene (cis), total, (μg/L)	5	10	0.0041	0.0082	1/Month	Grab

Carbon Tetrachloride, µg/L	5	10	0.0041	0.0082	1/Month	Grab
Chloroform, µg/L	5	10	0.0041	0.0082	1/Month	Grab
Methylene Chloride, µg/L	5	10	0.0041	0.0082	1/Month	Grab
Tetrachloroethene, µg/L	5	10	0.0041	0.0082	1/Month	Grab
Trichlorofluro-methane, µg/L	5	10	0.0041	0.0082	1/Month	Grab
1, 1, 1-Trichloroethane, (µg/L)	5	10	0.0041	0.0082	1/Month	Grab
trans-1,2-Dichloro-ethene, (µg/L)	5	10	0.0041	0.0082	1/Month	Grab
Vinyl Chloride, (µg/L)	5	10	0.0041	0.0082	1/Month	Grab
Trichloroethene, (µg/L)	5	10	0.0041	0.0082	1/Month	Grab

Table 2-6. OU1 - 5003 Authorization to Discharge Monitoring Requirements (continued)

ATD #1IN90010*AD						
Parameter	Discharge Limitations				Measurement Frequency	Sample Type
	Concentration 30 Day	Concentration Daily	Mass Loading (kg/day) 30 Day	Mass Loading (kg/day) Daily		
OUTFALL 003 - OU1 Pump and Treat Facility						
bis (2-ethylhexyl) phthalate, µg/L	—	—	—	—	Quarterly	24 Hr. Comp.
Acute toxicity, *ceriodaphnia dubia,* TUa	—	1.0	—	—	Quarterly	24 Hr. Comp.
Chronic toxicity, *ceriodaphnia dubia,* TUc	—	2.8	—	—	Quarterly	24 Hr. Comp.

Acute toxicity, *pimephales promelas,* TUa	—	1.0	—	—	Quarterly	24 Hr. Comp.
Chronic toxicity, *pimephales promelas,* TUc	—	2.8	—	—	Quarterly	24 Hr. Comp.

Flow meters with flow totalizers and flow-proportional samplers are installed on MEMP's outfalls. ES&C uses flow-proportional sampling systems at Outfalls 5002, 5601, and 5602. Each sampling event has a minimum aliquot volume of approximately 25-mL, which is automatically composited over a 24-hour period during the normal workweek and a 96-hour period during weekends. Refrigerated automatic composite samplers are used to maintain the temperature between 1^{o}C and 4^{o}C. In addition to automatic sampling, grab samples are collected for selected parameters at each outfall.

The discharge flow rates are measured at Outfalls 5002 and 5602 using a 90^{o} V-notch weir and float measurement systems. A mechanical float is used to sense the level of water flowing over the weir. Outfall 5601 employs a 10-inch Parshall flume and a Drexelbrook capacitance sensor to measure the discharge flow rate. The flow meters are calibrated to measure flow within 10 percent of the maximum flow rate that the meter is capable of measuring.

2.5.4 Procedures for Sample Collection and Analysis

Sampling procedures for each outfall, and the associated analytical procedures, are documented in Technical Manual MD-80030, *Environmental Analytical Procedures*. A brief summary of the specific procedures related to nonradiological liquid effluent follows; all are incorporated by reference into this Plan. It should be noted that certain parameter analyses are contracted to outside laboratories in order to meet EPA certification and BWXT of Ohio, Inc. quality assurance (QA) requirements.

Operation 8218, NPDES Parameters in Effluent Water, references analytical procedures approved by the EPA for measurement of NPDES constituents. Referenced procedures can be found in the Code of Federal Regulations (40 CFR 136) and *Standard Methods for the Examination of Water and Wastewater*. Although there are multiple methods for each parameter, only the methods used by MEMP and/or the vendor laboratory are referenced. Due to the number of procedures involved, they are not summarized individually.

Operation 9081, Routine Collection of Effluent Water Samples for Radioactive and NPDES Parameters, describes sampling locations, frequencies, and equipment used to collect samples from the Plant's liquid effluents for both radionuclide and nonradionuclide constituents. Flow-proportional composite samples are collected each workday morning from Outfalls 5601, 5602, 5002, and 003. Flow metering data from each of the monitoring stations is also documented. Additional grab samples are collected at frequencies specified by the NPDES permit.

2.6 Data Management and Quality Assurance

2.6.1 Data Logbooks

Analytical results are maintained in controlled logbooks and computer-based spreadsheets. The following logbooks are used to maintain radiological and nonradiological water effluent data. All are incorporated by reference into this Plan.

Mound Control Number	Title
6177A and 6177B	Sample Receipt Log
6445	Water Analysis Data NPDES
6943E	Uranium Water Analysis Record Onsite and Offsite
6943G	Plutonium Water Analysis Record Onsite and Offsite
8958A	Liquid Scintillation Analysis Data Logbook

2.6.2 Quality Assurance

Environmental sample collection and analytical procedures comprising MD-80030 establish chain-of-custody requirements and internal laboratory quality assurance practices. Quality assurance (QA) and quality control (QC) requirements are documented in the *Environmental Safeguards and Compliance Function Quality Assurance Plan* (MD-10176). These manuals describe participation in external QA programs, statistical measures of accuracy, precision, and confidence; and procedures for determining the types of quality assurance programs necessary for various environmental measurements. The manuals also describe self-assessment activities designed to verify adequacy and effectiveness of QA/QC practices.

3.0 METEOROLOGICAL MONITORING

MEMP's meteorological monitoring program provides information on weather conditions that can be used to forecast atmospheric dispersion following planned or unplanned releases of airborne material. Performance criteria and documentation requirements for meteorological monitoring programs at DOE facilities are detailed in the *Regulatory Guide* (DOE, 1991). Additional guidance applicable to the site has been issued by the U. S. Environmental Protection Agency (EPA, 1987).

3.1 Rationale

Pursuant to the *Regulatory Guide*, the principal uses of meteorological data at DOE sites are to assess the:

- consequences of routine atmospheric releases,
- consequences of unplanned atmospheric releases, and the
- potential consequences of atmospheric releases from new or modified facilities.

MEMP has an extensive network of hardware and software designed to meet these goals. Specific information on key elements of the monitoring program follows below.

3.2 Instrumentation

Primary tower. The primary tower is located on a topographic high referred to as the Main Hill. The elevation of the tower base is approximately 282 m (920 ft) above sea level. Instruments located on this tower measure wind speed, wind direction, and temperature at the 50-m (164-ft) level above the base. This elevation is comparable to the height at which materials are released into the atmosphere from the principal stacks on the Main Hill. At the 1-m (3-ft) level, temperature and dew point are measured. The tower is also equipped with a tipping bucket rain gauge.

Secondary tower. A second tower is located in a topographic low below the Main Hill. The elevation of the tower base is approximately 230 m (750 ft) above sea level. Wind speed, wind direction, and temperature are measured at the 10-m (33-ft) level. Operation of this tower ensures that MEMP can adequately characterize dispersion during ground-level and near-ground-level releases. Data from this tower are also used to evaluate transport and diffusion during conditions unfavorable to dispersion (e.g., calm winds at ground level and/or an inversion).

Atmospheric stability measurements. At MEMP, atmospheric stability determinations are made by estimating the amount of atmospheric turbulence in the lateral wind direction. This approach is the so-called "sigma a" (σ_A) approach, where σ_A represents the standard deviation of the fluctuation in the horizontal wind field. Sigma a values are determined for MEMP using a bi-directional wind vane.
Atmospheric stability assignments are then made for a given time period based on the σ_A value during that period. Large σ_A values indicate turbulent conditions (favorable for dispersion);

small σ_A values indicate stable conditions (unfavorable for dispersion).

3.3 Data Management

A Handar computer receives and summarizes signals from the sensors on the towers. A DEC computer then compiles the Handar data and generates records of wind speed, wind direction, wind stability, temperature, dew point, percentage relative humidity, and rainfall. Key data are archived permanently in a data base of 15-minute averages. The data are also available as hourly averages for use in dispersion calculations. MEMP's goal for recovery of data used to estimate annual dispersion patterns is 100%. Recent calendar year recovery rates for the data have ranged from 90.0 to 99.9 percent.

3.4 Routine Releases

To estimate dispersion of airborne materials released throughout the year, the principal information needed is the frequency of specific combinations of wind speed, wind direction, and atmospheric stability. These data are archived for each calendar year in the form of a joint frequency distribution (JFD). The JFD is then used to estimate annual average concentrations as a function of distance and compass sector relative to MEMP.

For atmospheric releases of radioactivity, MEMP uses the computer code CAP88-PC (EPA, 1992) to generate estimates of radionuclide concentrations in the offsite environment. In each case, the estimates are based on a straight-line Gaussian plume model.

Routine releases of nonradiological constituents to the atmosphere are limited to the materials shown in Table 2-5. Process knowledge, rather than a modeled approach, is typically used to estimate annual release rates. Further, because of the small volumes and masses released, modeled estimates of ground-level concentrations are rarely needed.

3.5 Emergency Response Capabilities

An important capability for the MEMP Plant is the ability to respond to unplanned releases of radioactive and/or chemical materials to the atmosphere. This capability could prove vital during an inadvertent release of materials from MEMP or a nearby industry.

Primary emergency response support for MEMP is maintained through its relationship with the Atmospheric Release Advisory Capability (ARAC) Group at Lawrence Livermore National Laboratory. During an unplanned release of gases or particulates to the atmosphere, source term and weather data are reviewed by the ARAC Group. The ARAC Group responds with real-time assessments of the potential consequences of the release. The ARAC Group consists of more than 30 scientists with baccalaureate and advanced degrees in such disciplines as meteorology, atmospheric science, computer science, and mathematics.

The chief wind field and diffusion models of ARAC are MATHEW and ADPIC, respectively. MATHEW is a mass-adjusted three-dimensional wind field model; ADPIC is an atmospheric diffusion particle-in-cell model. MATHEW/ADPIC can be used to generate puffs or plumes to evaluate:

- particulate and gaseous concentrations,
- particle deposition as a function of particle size, and
- rainout of distances up to several hundred kilometers.

The onsite capabilities associated with the ARAC system make it possible to provide real-time wind speed and direction information to the Emergency Operations Center (EOC) at 15-minute intervals. It is also possible to generate plume data (Figure 3-1) for transmission to the EOC. All onsite modeling capabilities utilize Gaussian plume and puff calculations.

Figure 3-1. ARAC-Generated Graphics: Simulated Plume Using Onsite Modeling Capabilities

4.0 ENVIRONMENTAL SURVEILLANCE

As described in Chapter 2, operations at the MEMP site result in the discharge of effluents to the air and the Great Miami River. To evaluate any impact these releases may have on human health and the environment, MEMP collects and analyzes numerous samples each year from a variety of environmental media. The sampling programs in place for each environmental medium are described in the following sections.

An effective environmental surveillance program requires comparisons of concentrations measured in the environment with background levels. For purposes of this report, a "background" location is defined as an area unaffected by MEMP releases. Background samples for MEMP are collected from areas that represent substantial distances from the site and/or the least prevalent downwind directions. Environmental monitoring samples, conversely, are collected from locations where impacts from MEMP operations are most likely to be detected.

4.1 Ambient Air

4.1.1 Program Objectives

MEMP maintains a network of ambient air surveillance stations to monitor the impact of airborne radiological emissions on the local and regional environments. Specifically, the goals of the ambient air monitoring program are to:

- document compliance with applicable federal, state, and local regulations and DOE Orders,
- quantify environmental impacts of planned and unplanned releases,
- verify proper operation of stack emission control mechanisms, and to
- promote public trust by providing accurate environmental data.

4.1.2 Operational Specifications

Two types of samples are collected continuously at each air sampling location. One type is air suspended particulate collection via filtration. The filters are analyzed for plutonium-238 and plutonium-239, 240, thorium-230, thorium-228, thorium-232 (Th for only selected locations), and "Mass loading" or dust concentrations. A second air sample, collected in a bubbler apparatus, is analyzed for tritium oxide (HTO). The sampling equipment is housed in a shelter of wood or metal construction. The shelters provide protection from disturbances relating to weather, tampering, or theft. Each side of these shelters, or "stations", has louvered panels to provide adequate air flow.

Siting Criteria

MEMP operates a network of 20 stations; eight onsite and 12 offsite locations. The locations of the stations are shown in Figures 4-1 and 4-2, respectively, for the offsite and onsite stations.

The number and placement of the offsite air sampling stations has been evaluated based on the methodology developed by Waite (1973a and 1973b). Waite's technique optimizes sampling station placement based on the population distribution and the prevailing winds. In that approach, the available sampling stations are preferentially sited in the compass sector that are home to the largest numbers of people and/or are in the prevailing downwind directions. One exception to that rule applies. To establish background concentrations, one station is located in the least prevalent wind direction.

During 1996, two stations were added to the monitoring network (Stations CLN and CLS). These were positioned midway between existing stations proximate to the CERCLA Miami-Erie Canal remediation project. Upon completion of the project excavation activities CLS was removed from operation. The CLN station still remains in the air monitoring network.

As seen in Figure 4-2, the onsite stations have been sited near the Plant perimeter to provide estimates of impacts at the site boundary or "fence line". The onsite stations were placed based on:

- their proximity to operational areas, and/or
- their proximity to decommissioning activities, and
- the prevailing wind directions for the site.

The shelters are located, to the extent feasible, in areas free from localized effects such as buildings, trees, or fugitive dust sources. Siting requirements established in the *Regulatory Guide* and 40 CFR Part 58, Appendices A through E are consulted during inspections of shelter locations. The guidelines are also consulted prior to shelter construction or relocation.

Figure 4-1. Offsite Air Sampling Locations

Figure 4-2. Onsite Air Sampling Locations

Plutonium Sample Collection and Analysis

Plutonium samples are collected at a height of approximately 0.7 m (2.3 ft.). The use of a 0.7-m sampling height provides MEMP with a mechanism of detecting plutonium released from the site stacks and from the ground surface. The release of plutonium from ground surfaces (resuspension) is a potentially significant transport mechanism for the site. In the past, onsite samples were also collected from a height of 2 m. In this way onsite impacts from elevated, as well as ground-level, releases could be fully evaluated. In 1996, a comparison of data from the two sampling heights was performed (Farmer, 1996). The comparison indicates that data from the 0.7-m height is generally more conservative. Two-year averages of data collected between 1994 and 1996 were greater at the 0.7-m sampling height than at the 2-m sampling height with two exceptions (Stations 215 and 217). As a result, the 2-m sampling height has been abandoned at all stations except 215. Station 215 retains both the 0.7-m and 2-m sampling elevations to evaluate impacts from the Miami-Erie Canal remediation project and for continued comparison between the two sampling heights. Station 217 is not located in the prevailing wind direction. Plutonium concentrations at 217 are very low and not likely to affect dose estimates from site operations. Therefore, only the 0.7-m sampling elevation will be used at this 217.

Sample collection. Plutonium and thorium concentrations in air are determined based on the collection of particulate matter on a ultra-pure quartz fiber filter. Air is passed across the filter at a nominal flow rate of $1.3x10^6$ cm^3/min (45 cfm). The filter in use at MEMP removes 99.99% of the particles in the 0.06 - 0.4 micron range. The removal efficiency for particles of 0.5 microns and larger is 99.999%.

The filter is changed weekly and represents a sample volume of approximately 13,000 m^3 of air. Experience at MEMP has shown this retrieval time interval to be sufficient to detect radionuclides of MEMP origin. This collection frequency also provides an opportunity to conduct weekly inspections of the stations. Typical lower limits of detection for this technique are on the order of 10^{-18} µCi/mL.

Sample analysis. Filters collected from the eight onsite stations and three offsite stations (Stations 104, 124, and CLN) are analyzed monthly by compositing the weekly samples. Weekly filter samples from the remaining stations are analyzed quarterly. The parameters measured are Pu-238 and Pu-239, 240. Samples from Stations 213, 215, 216, 218, 119, and 124 are also analyzed for Th-228, Th-230, and Th-232. The protocols followed to analyze the samples are documented in Technical Manual MD-80030, *Environmental Analytical Procedures*. The applicable operations are Operation 9300, Collection of Environmental Air Samples; and Operation 1162, Plutonium and Thorium in High Volume Air Filters by an Acid Leach Method. The analytical procedures involve sample decomposition with heat, followed by leaching with nitric and hydrochloric acids. The plutonium and thorium are separated by anion exchange chromatography and electrodeposited on stainless steel slides. Alpha pulse height analysis is then performed (Operation 9317, Environmental Monitoring Alpha Spectroscopy Method).

Particulate Load Determinations

The filters from the high-volume air samplers described above are also used to determine concentrations of particulates in air at onsite sampling locations. These measurements verify that dust levels associated with site activities, such as construction and traffic, do not exceed expected levels. The protocol followed to generate the concentration data is documented in Technical Manual MD-80030, *Environmental Analytical Procedures*. The applicable operation is Operation 9300, Collection of Environmental Air Samples. Given (1) the weight of the filter before and after use, and (2) the volume of air to which the filter was exposed, the average particulate-in-air concentration for that exposure period is readily determined.

Tritium (HTO) Sample Collection and Analysis

Tritium samples are collected at heights of 1 - 2 m (3 - 6 ft) The use of this range of sampling heights is adequate to detect tritium oxide released from the site stacks.

Sample collection. Tritium oxide (HTO) concentrations in air are determined based on the collection of tritiated water vapor in ethylene glycol. Ethylene glycol is used as the trapping agent because it is not subject to loss by evaporation and will not freeze when exposed to winter sampling conditions. Ethylene glycol removes 85 - 95% of the tritiated water vapor from the air.

Ambient air is passed through 200 mL of glycol at a nominal flow rate of 1000 cm^3/min (0.03 cfm). The glycol solution is changed weekly and represents a sample volume of approximately 10 m^3 of air. Experience at MEMP has shown this retrieval interval to be sufficiently lengthy to detect HTO of MEMP origin. This collection frequency also provides an opportunity to conduct weekly inspections of the stations. Typical lower limits of detection for this technique are on the order of $20x10^{-12}$ μCi/mL.

Sample analysis. The ethylene glycol solutions collected weekly from each of the 20 sampling stations are analyzed using a liquid scintillation counting technique. Mound protocols followed to collect and analyze the samples are documented in Technical Manual MD-80030, *Environmental Analytical Procedures*. The applicable procedure is Operation 2157, Tritium Oxide Analysis in Ambient Air. In Operation 2157, a two-mL aliquot of each ethylene glycol sample is added to 20 mL of a liquid scintillation cocktail prior to liquid scintillation analysis. The nominal counting period is 200 minutes. Operating procedures 2157 and 9300 are incorporated by reference into this EMP.

4.2 Surface Water and Sediment

4.2.1 Program Objectives

MEMP's surface water and sediment monitoring programs have been designed to meet the requirements of DOE Order 5400.1 and 5400.5 and the *Regulatory Guide*. Specific program goals are to:

- detect, characterize, and report planned and unplanned releases, and to
- monitor overall water quality.

4.2.2 Sample Collection and Analysis

The Great Miami River and other regional surface waters are sampled routinely by MEMP for tritium, plutonium, uranium, and thorium isotopes. Sediment samples are also collected from these locations and analyzed for plutonium and thorium isotopes. Sampling locations and frequencies have been established based on historical patterns. Sampling locations or radionuclides that do not exhibit significant changes in concentration over numerous sampling periods may be eliminated or sampling frequencies reduced. Conversely, locations or radionuclides may be added to the program. Approximate sampling locations are shown in Figure 4-3. Sampling and analytical procedures used to evaluate surface water samples are documented in Technical Manual MD-80030, *Environmental Analytical Procedures*. The applicable procedures are identified in Table 4-1; all such procedures are incorporated by reference into this EMP.

Great Miami River. Six river locations are routinely sampled by all such procedures are incorporated by reference into this MEMP. The locations provide samples that are representative of river water before and after complete mixing of MEMP's effluents with the river. Sampling protocols have been designed to ensure that water sample collection is representative of water flowing past the sampling site. Tritium, plutonium-238, plutonium-239,240, uranium-233,234, and uranium-238 samples are collected and analyzed monthly, thorium-228, thorium-230, and thorium-232 are analyzed quarterly. A local creek is also sampled monthly for tritium and gross alpha.

Regional surface waters. To detect atmospheric deposition on water, it is also necessary to sample area lakes and/or ponds. Seven ponds in various directions from MEMP are sampled annually. Samples are collected in the fall. These samples are analyzed for tritium, plutonium-238 and plutonium-239,240. When possible pond sampling locations concentrate monitoring efforts in the prevalent wind direction.

Sediments. Many plutonium and thorium solutions, including those used at MEMP, are relatively insoluble in water. Therefore, they are more likely to be found in sediment than in surface water. Additionally, because of their relatively long half-lives, they have the potential to accumulate in sediments over a number of years.

For this reason, MEMP samples river sediments quarterly and pond sediments annually. Samples are collected during the fall season. Sediment from a local creek is also sampled quarterly. These samples are then analyzed for plutonium-238, plutonium-239,240, thorium-228, thorium-230, and thorium-232

Figure 4-3. Sampling Locations for River Water, Pond Water, and Sediments

River Sampling Locations

2 State Route 123, west of Middletown
4 Chautauqua Road Bridge
5 midway between the Outfall 001 discharge pipe and the Mound Overflow Creek
6 Tipp-Elizabeth Road Bridge, Tipp City
7 Adjacent to the Outfall 001 discharge pipe
8 Adjacent to the Mound Overflow Creek

Pond Sampling Locations

11 Camp Hook, west of Carlisle
12 Red Lion-Five Points Road, Springboro
14 South Union Road, Miamisburg
15 Union Road, Miamisburg
17 Sycamore Park, south of SR-725
18 North Heinke Road, north of SR-725
BKG West Alexandria Road, south of SR-35

Table 4-1. Procedures for Surface Water and Sediment Sample Collection and Analysis

Operation No.	Title

9294	Sampling of Subsurface Waters
9296	Sediment Collection for Radiological Analysis
1263	Plutonium and Thorium in Water by Coprecipitation Anion Exchange Method
1385	Leachable Plutonium in Solid Matrix
9337	Dissolution Method for Radionuclides in Solid Matrix
3266	Uranium in Water by Coprecipitation Anion Exchange Method
2261	Liquid Scintillation Analysis of Water Samples

All procedures are documented in Technical Manual MD-80030, *Environmental Analytical Procedures*, and are incorporated by reference into this EMP.

4.3 Aquatic Biota

In the past, chronic and acute toxicity testing of certain indicator species was performed on samples collected from the Great Miami River in conformance with the site's NPDES permit. This sampling is no longer an NPDES permit requirement and has been discontinued. As noted in Table 2-6, toxicity testing is currently a quarterly parameter at the OU1 Pump and Treat outfall.

The *Regulatory Guide* (DOE, 1991) suggests sampling and analysis of aquatic foodstuffs if the annual EDE is greater than 0.1 mrem and to ensure that the dose to aquatic biota does not exceed 1 rad/day. The expected dose to an aquatic organism a result of MEMP operations is expected to be on the order of 10^{-5} rad/day (Roepke, 1996). The CEDE from the ingestion of these fish is on the order of 10^{-3} mrem/year (Annual Site Environmental Reports). Because the doses to aquatic biota and humans have been demonstrated to be orders of magnitude below suggested guidelines for sampling, MEMP has discontinued fish sampling.

4.4 Produce

Various locally grown produce samples are collected each year. The intent of this aspect of the environmental monitoring program is to determine whether radionuclides of MEMP origin are being deposited on, or otherwise accumulated by, specific indicator species. Results of the analyses are used to monitor long-term concentration and accumulation trends, and to evaluate potential doses via the ingestion exposure pathway. The sampling locations, media, and radionuclides of interest are shown in Table 4-2. Collections locations and type are subject to produce availability. Additional locations and samples may be added and/or some locations not sampled. As seen in the table, tomatoes, because of their high water content, are used as the primary media for the tritium uptake indicator. Conversely, for plutonium-238, root crops are used because of their extensive contact with soil. If available, locally grown vegetation and foodstuff samples are collected from each location annually. Substitutes for reference media may be used, e.g. various high moisture vine crops in place of tomatoes and various root crops in place of potatoes. Tipp City and/or Eaton service as environmental background locations.

Table 4-2. Produce Sampling Program

Location	Media	Radionuclides
Miamisburg	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium
Centerville	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium
West Carrollton	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium
Springboro	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium
Germantown	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium
Miami Township	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium
Tipp City (a) or Eaton	Leafy vegetables	Tritium, ^{238} Pu, $^{239, 240}$Pu
	Root crops	^{238}Pu, ^{239,240}Pu
	Tomatoes	Tritium

The applicable collection and analysis procedures for the media and radionuclides of Table 4-2 are documented in Technical Manual MD-80030, *Environmental Analytical Procedures*. The specific operations which are incorporated by reference into this EMP are Operation 9290, Collection of Vegetation Samples for Radiological Analysis, Operation 1385, Leachable Plutonium in Solid Matrix, and Operation 2722, Distillation of Tritium in Solids.

4.5 Groundwater

Groundwater surveillance is the subject of a separate plan, the *Groundwater Monitoring Program* *and Groundwater Protection Management Program Plan* (DOE, 1997), or "GWMP", as required by DOE Order 5400.1. A brief summary of the GWMP is presented in the following sections. For more detailed information on groundwater monitoring program elements, the reader is directed to the GWMP which is incorporated by reference in this EMP.

4.5.1 Introduction

The GWMP summarizes routine groundwater monitoring programs at MEMP. Elements include Safe Drinking Water Act (SDWA) monitoring of the site's drinking water system and supplemental monitoring programs. Supplemental monitoring is not a regulatory requirement but is implemented as a best management practice (BMP) to ensure that the Plant is operating in a manner that is protective of groundwater.

4.5.2 History

Groundwater history relating to the MEMP has been well documented. A brief description can be found in the GWMP. Detailed hydrogeologic information about lithology, stratigraphy, and hydraulic properties of the Buried Valley Aquifer (BVA) and the bedrock groundwater flow system in the MEMP vicinity can also be found in the *Buried Valley Aquifer Report* (DOE, 1994b) and *Bedrock Report* (DOE, 1994a).

Information regarding the type and source of groundwater contamination has also been documented. The *OU9 Site Scoping Report Volume 7: Waste Management* (DOE, 1993c) provides historical information about waste-producing processes and waste management practices at the site. Baseline contamination levels can be found in the *OU9 Site Scoping Report Volume 3: Radiological Site Survey* (DOE, 1993b) and the *Groundwater Sweeps Report* (DOE, 1995a).

4.5.3 Groundwater Sources

Investigations have identified two sources of groundwater. Groundwater movement within bedrock is limited to joint and fracture flow, forming a perched water system. In areas where the bedrock intersects the ground surface, seeps have formed. The bedrock groundwater system is not a potable water source and its capacity and flow are limited. However, this system serves as a mechanism for transporting contamination from the main hill of the site to the adjacent river valley.

Figure 4-4. Production and Monitoring Well Locations

The second source of groundwater is the BVA. The groundwater flow in the BVA generally follows the bedrock topography. The BVA is the major source of potable water for the MEMP and neighboring communities. Consequently, the BVA was designated a sole source aquifer by the U. S. EPA in May of 1988. Protection of this aquifer is a concern for MEMP since the BVA extends onto the western and southwestern portions of the site. Contamination released onsite at the fringes of the BVA has the potential to migrate further into the BVA.

4.5.4 Groundwater Monitoring Network

MEMP has approximately 200 active groundwater monitoring sites both onsite and offsite to characterize the impact site operations may have on the BVA. Included in these sites are production wells, monitoring wells, piezometers, capture pits, residential wells, and community water supplies. Production and monitoring well locations are shown in Figure 4-4. Monitoring wells in use meet EPA Technical Enforcement Guideline Document specifications. Residential wells and other sources for which little technical information is known about integrity and construction are used primarily to evaluate trends.

SDWA Monitoring

The Safe Drinking Water Act (SDWA) of 1974 instructed the U. S. EPA to establish a program to protect drinking water sources. To meet this goal, the EPA developed national primary and secondary drinking water standards. These standards are applied to drinking water supplies "at the tap." Since MEMP withdraws well water for use as drinking water, the Plant is subject to the Act. SDWA requirements for public water systems are enforced by the OEPA through the Ohio Administrative Code (OAC) Chapters 3745-81 and 3745-82. Regulations require regular monitoring of drinking water sources and points of distribution for bacteriological, inorganic, and organic constituents known to be detrimental to human health. SDWA monitoring requirements are summarized in Table 4 of the GWMP.

Supplemental Monitoring

Supplemental monitoring is segregated into categories: community and worker assurance and early warning monitoring. Community and worker assurance monitoring consists of programs to monitor radionuclide concentrations in local drinking water supplies and monitoring wells downgradient of the site. The radionuclides of interest are tritium, plutonium, uranium, and thorium. Early warning monitoring includes sampling of wells both onsite and offsite to monitor areas of known contamination and provide early warning of the migration of contamination. Early warning monitoring focuses on radionuclides, metals, and organic compounds. Additionally, the onsite production wells are sampled for radionuclides. This sampling is not required by the SDWA but is performed as a BMP to ensure the quality of drinking water for workers and establish a baseline for effluent comparison.
Table 4.3 of the GWMP describes the locations and frequencies of supplemental groundwater sampling. Sampling locations and frequencies for the community and worker assurance categories are also shown in Table 4-3 of this Plan.

Table 4-3. Supplemental Sampling of Wells and Water Supplies for Radionuclides

Offsite production and private wells (a)	H-3	Pu-238, Pu-239,240	U-233,234, U-238	Th-228, Th-230, Th-232
0904	•			
0905	•			

0906	•			
0907	•			
0909	•			
0912	•			
Community water supplies (b)				
Franklin	•			
Germantown	•			
Miamisburg	•	•	•	•
Middletown	•			
Springboro	•			
W. Carrollton	•			
Tipp City (background)	•	•	•	•

(a) Sampled monthly (seasonally)
(b) Sampled monthly
Well locations are shown on Figure 4-4

Table 4-3. Supplemental Sampling of Wells and Water Supplies for Radionuclides (continued)

	H-3	Pu-238, Pu-239,240	U-233,234, U-238	Th-228, Th-230, Th-232
Offsite monitoring wells (a)				

0127, 0387	•			
0128	•			
0303	•	•	•	•
0376, 0377, 0378	•	•	•	•
0383, 0386, 0388	•	•	•	•
Onsite production wells (b)				
0071	•	•	•	•
0271	•	•	•	•
0076	•	•	•	•
Tributary valley (PRS 66) monitoring wells				
0111, 0119, 0125	•	•	•	•
0314, 0315, 0345, 0346	•	•	•	•

(a) Sampled quarterly for tritium, semi-annually for plutonium, uranium, and thorium
(b) Sampled weekly for tritium, monthly for plutonium, thorium, and uranium.
Well locations are shown on Figure 4-4

4.5.5 Methods and Procedures

All methods and procedures relating to groundwater monitoring activities follow the guidelines set forth in the GWMP. All analyses conducted to meet the requirements of the SDWA are performed by an OEPA-certified laboratory. Supplemental monitoring activities are performed in accordance with procedures listed in Technical Manual MD-80030, *Environmental Analytical Procedures* and/or the *Methods Compendium* (DOE, 1996b). Technical Manual MD-80030 is incorporated by reference into this EMP. Compliance with this Plan requires that only the most current version of procedures be applied.

4.6 Multi-Media Quality Assurance Programs

In addition to the program-specific QA activities described in previous sections of this Plan,

Environmental Monitoring Plan for MEMP

MEMP participates in QA exercises sponsored by the DOE. Such exercises provide objective evaluations of the validity of the environmental data generated by MEMP. In addition to these external QA programs, MEMP performs internal QA studies that make use of field and reagent blanks, internal standards, and duplicate samples.

4.6.1 EML QA Program

Twice each year, DOE's Environmental Monitoring Laboratory (EML) conducts blind environmental sampling exercises for DOE sites. Each participating lab is provided air filter, vegetation, water, and soil samples to analyze for radiological constituents. A laboratory's performance is then evaluated by comparing their results to EML reference values. Mound's performance is documented each calendar year in the annual site environmental report.

4.6.2 MAPEP QA Program

The Department of Energy (DOE) Office of Environmental Management (EM) currently operates its environmental programs under the jurisdiction of various regulatory agencies. Compliance and quality assurance issues associated with these regulatory authorities typically require analytical services under contract with DOE to participate in a variety of performance evaluation programs (PEPs). "The primary objective of the MAPEP is to foster reliability and credibility for the analytical results used in the decision making process, particularly as it relates to the environment and public health and safety. The Analytical Services Division of EM directs the MAPEP to assure the quality of analytical services across the DOE Complex."[1]

The Radiological and Environmental Sciences Laboratory (RESL), under the direction of EM, administers the MAPEP. The MAPEP samples analyzed by the Environmental Laboratory include liquid and solid matrices with environmentally important radioactive constituents.

BWXTO Environmental Safeguards & Compliance (ES&C) Effluent & Environmental Analytical Services (EEAS) laboratory participates in this PEP to check specific analytical proficiencies in radiological analyses. Any DOE service laboratory that performs environmental analytical measurements (i.e., radiological, stable inorganic, and/or organic analyses, solely or in any combination) are required to participate (Memorandum from the Assistant Secretary for Environmental Management, May 31, 1994, Newberry: 3-7615). Participation is defined as requesting the MAPEP sample materials, completing the appropriate analyses, reporting the results to RESL, and implementing any corrective actions. The Laboratory Code for MEMP (BWXT of Ohio) is EMBW01

MAPEP samples, solid or liquid, are analytical standards generated for the purpose of securing and evaluating analytical services. The Environmental Monitoring laboratory of BWXT of Ohio performs analyses according to the following:

Sample Type	Parameters	Frequency
Soil	Pu-238, 239/240	Annually
	U-233/234, 238	Annually

Water	Pu-238, 239/240	Annually
	U-233/234, 238	Annually

Results are flagged as "acceptable" (A), "warning" (W), or "not acceptable" (N). A result is acceptable if a bias less than or equal to 20% is obtained. A warning is received for a result with a bias greater than 20% but less than 30%. A not acceptable rating is received when a bias greater than 30% is obtained. Twice each year, DOE's Environmental Monitoring Laboratory (EML) conducts blind environmental sampling exercises for DOE sites. Each participating lab is provided air filter, vegetation, water, and soil samples to analyze for radiological constituents. A laboratory's performance is then evaluated by comparing their results to EML reference values. Mound's performance is documented each calendar year in the annual site environmental report.

4.6.3 Internal QA Program

MEMP performs a number of internal QA operations. Blank samples are analyzed to verify the absence of excessive instrument contamination or background. The standard deviation of the blanks is then used to calculate the lower limit of detection. MEMP also routinely uses duplicate sample analysis and internal standard techniques to evaluate analytical precision. Deviations from expected values result in comprehensive reviews of the appropriate protocols.

4.6.4 Sample Tracking Procedures and Data Management

A primary objective of the environmental monitoring program at MEMP is to ensure that adequate procedures are in place to track samples and archive data. MEMP tracks samples via a series of chain-of-custody protocols incorporated into sample collection and analysis methods.

Data management activities are governed by MD-80030 and MD-80033, *Environmental Assessment Procedures*. MD-80033 documents the various data formats, log sheets and calculational routines used to generate environmental concentration data. MD-80033 is incorporated by reference into this EMP.

5.0 DOSE CALCULATIONS

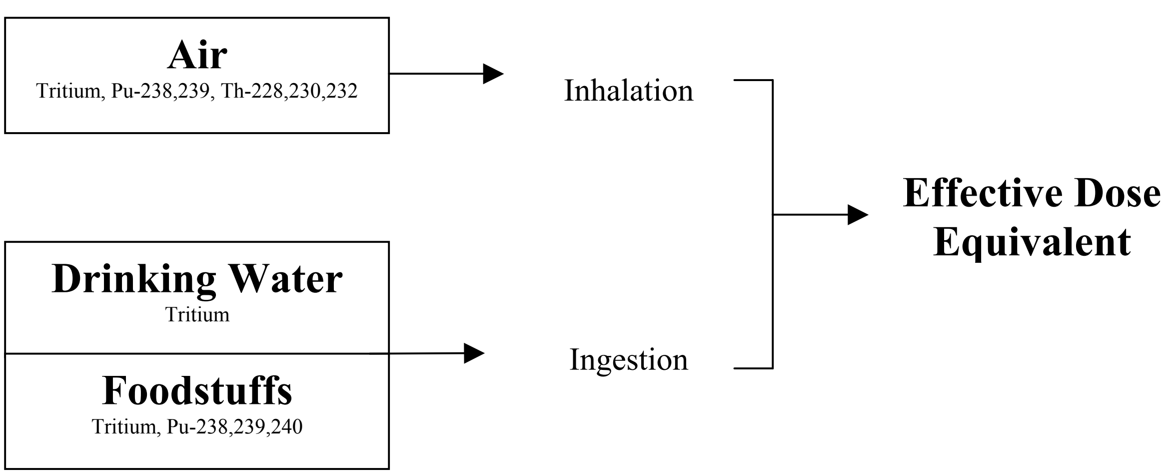
MEMP personnel estimate "maximum" offsite dose equivalents for each calendar year of operation. Estimates of offsite population doses are also generated. The methodologies used by MEMP to meet applicable dose reporting requirements are described below.

5.1 Exposure Routes

Members of the public receive radiation doses from a number of exposure pathways. For radionuclides discharged to the atmosphere, a person may inhale or be immersed in airborne radioactivity. Other routes of airborne exposure include ground deposition of radionuclides and consumption of food products contaminated by airborne releases. For radionuclides released to water, a person may consume contaminated water or fish. Other potential water-based exposure pathways involve such activities as boating and swimming. Typically, these routes of exposure are not significant contributors to dose.

The significance of a given exposure route is highly dependent on the nature of a facility's operations and the types of radionuclides handled there. The important exposure pathways for MEMP are shown in Figure 5-1. Figure 5-1 also identifies the radionuclides associated with each exposure route.

Figure 5-1. Exposure Pathways for Dose Calculations



5.2 Dose Estimates Based on Measured Concentrations

For DOE reporting requirements, doses are presented as 50-year committed effective dose equivalents (CEDEs). The CEDE is the total dose equivalent that will be received by an individual over a 50-year time period as a result of one year of exposure to ionizing radiation. The total CEDE reported is the sum of the CEDEs from the air and food related.

CEDEs are calculated based on measured concentration data for a specific radionuclide. A CEDE is calculated as shown below. The sampling locations with the maximum annual average concentrations of the various environmental media are used to calculate CEDEs. If detectable concentrations of other radionuclides are observed, these values will be included in appropriate dose calculations. Table 5-1 also specifies other parameter values used in this equation.

$$CEDE = \Sigma\, C_r \bullet I_a \bullet DCF \bullet CF$$

where: CEDE = Total committed effective dose equivalent, mrem

$\sum_{1}^{p}$ = summation over the exposure pathways 1 through p

C_r = maximum average concentration of the radionuclide

I_a = annual intake of the environmental medium

DCF = dose conversion factor for the radionuclide and intake type

CF = conversion factors as needed

Table 5-1. Factors Used to Calculate CEDEs

Radionuclide	Dose Conversion Factor (mrem/μCi)		
Tritium		**Thorium-228**	
Air	6.3×10^{-2} (a)	Air	3.1×10^{5}
Drinking Water	6.3×10^{-2}		
Plutonium-238		**Thorium-230**	
Air	3.8×10^{5} (b)	Air	3.2×10^{5}
Plutonium-239		**Thorium-232**	
Air	4.2×10^{5}	Air	1.6×10^{6}

Annual Intake Values

~~Air~~	~~8400 m^3~~
Drinking Water	730 L
Ingestion	$260Y_2$

(a) To calculate the CEDE, the dose factor shown in the table is multiplied by 1.5 to include absorption of tritium through the skin.
(b) Plutonium releases from Mound are believed to be insoluble (Class Y). However, to provide a reasonable degree of conservatism in the dose estimates, the Pu-238 and Pu-239 doses factors used are averages of Class W and Class Y values.

To provide an extra degree of conservatism, dose estimates are calculated based on maximum exposure conditions. The "maximum offsite individual dose", as defined for purposes of calculating a CEDE, is a hypothetical person who remains at the site boundary 24 hours per day throughout the year. This individual is assumed to have:

- continually breathed air containing the highest average radionuclide concentrations found at an air sampling station and
- drawn all of his drinking water from the offsite well with the highest average radionuclide concentrations.
- Ingested Foodstuffs with the highest average radionuclide concentrations.

5.3 Dose Estimates for NESHAPs Compliance

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) radionuclide regulations (40 CFR 61, Subpart H) limit offsite doses from DOE facilities to 10 mrem effective dose equivalent (EDE) per year. As specified in 40 CFR 61, Subpart H, the preferred technique for demonstrating compliance with the dose standard is a modeled approach.

MEMP uses the U. S. EPA's computer code CAP88-PC to evaluate doses for NESHAPs compliance (EPA, 1992). The stack-specific parameters used as input to the code are shown in Table 5-2. Other key input data include annual radionuclide release rates and meteorological data for the year of interest. Whenever possible, MEMP uses site-specific data as input to the code.

The output from the CAP88-PC run provides an estimate of the maximum offsite EDE via atmospheric exposure routes. This dose is then compared with the 10-mrem standard for purposes of evaluating compliance with 40 CFR 61, Subpart H. CAP88-PC also produces estimates of offsite population doses via atmospheric exposure routes. These doses are also reported to the U. S. EPA on an annual basis.

Table 5-2. CAP88-PC Input Data

Stack ID	Stack Height (meters)	Stack Diameter (meters)	Exit Velocity (meters/sec)	Radionuclide(s)	1999 Release Rate (Ci/yr)

HH	34	1.7	1.3	Tritium	3.1×10^{0}
NCDPF	41	0.6	27.9	Tritium	2.8×10^{1}
SM/PP	60	1.8	5.6	Pu-238	1.0×10^{-5}
				Pu-239,240	2.1×10^{-8}
				U-233,234	1.5×10^{-9}
				U-238	7.1×10^{-10}
SW-1CN	46	0.9	13.7	Tritium	9.0×10^{0}
				Pu-238	3.5×10^{-9}
				Pu-239,240	3.6×10^{-10}
				U-233,234	5.4×10^{-10}
				U-238	6.8×10^{-10}
T-West	60	2.4	13.4	Tritium	2.1×10^{2}
				Pu-238	6.0×10^{-7}
				Pu-239,240	9.8×10^{-9}
				U-233,234	4.1×10^{-9}
				U-238	3.3×10^{-9}
T-East	60	1.8	8.3	Tritium	9.0×10^{-2}
HEFS	46	1.9	10.2	Tritium	5.5×10^{2}
				Pu-238	8.2×10^{-9}
				Pu-239,240	9.9×10^{-10}
				U-233,234	1.6×10^{-9}
				U-238	1.2×10^{-9}
WDSS	16	0.3	11.2	Pu-238	2.7×10^{-9}
				Pu-239,240	6.1×10^{-11}
WDA	9	1.0	10.5	Tritium	4.0×10^{-1}
				Pu-238	5.9×10^{-8}
				Pu-239,240	3.3×10^{-10}
				U-233,234	1.6×10^{-10}
				U-238	7.9×10^{-10}
Building 22	7	0.9	0[a]	Tritium	2.4×10^{0}
Building 23	2	0.3	0[a]	Tritium	6.2×10^{0}
CWPF	9	0.8	12.1	Tritium	4.0×10^{-3}
				Pu-238	9.2×10^{-10}
				Pu-239,240	7.6×10^{-11}
				U-233,234	1.6×10^{-10}
				U-238	4.0×10^{-10}

[a] No credit taken for exit velocity due to orientation of the building vent.

6.0 PREPARATION AND DISPOSITION OF REPORTS

This chapter provides an overview of the reporting requirements applicable to the environmental monitoring programs at MEMP. Such requirements have been established by federal and local statutes and regulations, and by DOE Orders. Table 6-1, which begins on the following page, summarizes these requirements. In the table, reports, due dates, and regulatory drivers are identified.

Timely submission of the majority of these reports is the responsibility of the Environmental Safeguards and Compliance Group of BWXT of Ohio, Inc.. Reporting responsibilities for unplanned "environmental occurrences" and releases in excess of "reportable quantities" are specified in Tech Manual MD-10367*, DOE Order 232.1 Occurrence Reporting and Processing of Operations Information Plan*. DOE Order 232.1 (DOE, 1995b) and MD-10367 are incorporated by reference into this EMP.

Table 6-1. Applicable Reporting Requirements

Report	Due Date	Driver	Description
Annual Site Environmental Report	October 1	DOE Order 5400.1	The annual site environmental report summarizes radiological and nonradiological environmental monitoring results for the previous calendar year. The report describes the status of the facility with respect to major environmental statutes and permit conditions. Effluent data for the previous year, and estimates of potential offsite impacts, are also included. The report is submitted to DOE for distribution to the public.
Annual NESHAPs Compliance Report	June 30	40 CFR 61, Subpart H	This report documents the site's compliance with the dose standard of 40 CFR 61, Subpart H. The report is submitted to the U. S. EPA through the U. S. DOE.
SARA Title III Section 311, 312 Report	March 1	SARA Title III, Emergency Planning and Community Right-to-Know Act	Facilities at which "hazardous" and "extremely hazardous" chemicals are stored or used in excess of specific thresholds must submit annual inventory information to the local emergency planning commissions, state emergency response agencies, and local fire departments. The report is submitted to these agencies through DOE.
SARA Title III Section 313 Report	July 1	SARA Title III, Emergency Planning and Community Right-to-Know Act	Facilities releasing hazardous materials in excess of specific thresholds must file a Toxic Chemical Release Inventory form, Form R, each year with the state and/or federal EPA.

Table 6-1. Applicable Reporting Requirements (continued)

Report	Due Date	Driver	Description
Discharge Monitoring Report	Monthly	Clean Water Act, NPDES permit	Facilities governed by a National Pollutant Discharge Elimination System permit must submit discharge data each month to the state and/or federal EPA. The report documents the site's compliance status for each regulated outfall.
Safe Drinking Water Act Reports	As required	Ohio Administrative Code	Pursuant to the Ohio Administrative Code, public water systems must monitor for contaminants known to be detrimental to human health. Monitoring results are submitted to the state and/or federal EPA. Reporting frequencies vary for each constituent monitored.
Radioactive Effluent and Onsite Discharge Data Reports	April 1	DOE Order 5400.1	All offsite and onsite releases of radioactive materials in airborne and liquid effluents must be reported annually to DOE via Bechtel BWXT Idaho, Idaho Falls, Idaho.

7.0 REFERENCES

40 CFR 58. *Ambient Air Quality Surveillance.*

40 CFR 61, Subpart H. *National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities.*

40 CFR 136. *Guidelines Establishing Test Procedures for the Analysis of Pollutants.*

DOE, 1990. U. S. Department of Energy Order 5400.1, *General Environmental Protection Program.*

DOE, 1991. U. S. Department of Energy, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, Report Number DOE/EH-0173T, Assistant Secretary for Environment, Safety and Health, Washington, D. C.

DOE, 1993a. U. S. Department of Energy Order 5400.5, *Radiation Protection of the Public and the Environment.*

DOE, 1993b. U. S. Department of Energy, Site Scoping Report: *Volume 3 - Radiological Survey, Mound Plant, Miamisburg, Ohio,* Albuquerque, NM.

DOE, 1993c. U. S. Department of Energy, Site Scoping Report: *Volume 7 - Waste Management, Mound Plant, Miamisburg, Ohio,* Albuquerque, NM.

DOE, 1994a. U. S. Department of Energy, *OU9 Hydrogeologic Investigation: Bedrock Report, Mound Plant,* Miamisburg, OH.

DOE, 1994b. U. S. Department of Energy, *OU9 Hydrogeologic Investigation: Buried Valley Aquifer Report, Mound Plant,* Miamisburg, OH.

DOE, 1995a. U. S. Department of Energy, *OU9 Hydrogeologic Investigation: Groundwater Sweeps Report, Mound Plant,* Miamisburg, OH.

DOE, 1995b. U. S. Department of Energy Order 232.1, *Occurrence Reporting and Processing of Operations Information.*

DOE, 1996b. U. S. Department of Energy, *Methods Compendium, Mound Plant,* Miamisburg, OH.

DOE, 1997. U. S. Department of Energy, *Groundwater Monitoring Program and Groundwater Protection Management Program Plan (Revision 1), Mound Plant,* Miamisburg, Ohio.

EPA, 1987. U. S. Environmental Protection Agency, *On-Site Meteorological Program Guidance for Regulatory Modeling Applications,* Office of Air Quality Planning and Standards, Research Triangle Park, NC.

EPA, 1992. U. S. Environmental Protection Agency, *User's Guide for CAP88-PC, Version 1.0,* Report Number 402-B-92-001, Office of Radiation Programs, Las Vegas, NV.

Farmer, 1996. B. M. Farmer to L. R. Bauer, *Pu-238 Air Sample Comparison,* December 1996.

MD-10176. *Environmental Group-Quality Control Manual,* Issue 8, EG&G Mound Applied Technologies, Miamisburg, OH.

MD-10367. *DOE Order 232.1 Occurrence Reporting and Processing of Operations Information Plan,* Issue 1, EG&G Mound Applied Technologies, Miamisburg, OH.

MD-80030. *Environmental Analytical Procedures,* Issue 30, BWXT of Ohio, Inc., Miamisburg, OH.

MD-80033. *Environmental Assessment Procedures,* Issue 3, EG&G Mound Applied Technologies, Miamisburg, OH.

MD-80042. *Air Monitoring Procedures Manual,* Issue 3, EG&G Mound Applied Technologies, Miamisburg, OH.

Roepke, 1996. P. Roepke, *Aquatic Dose Evaluation*, EG&G Mound Applied Technologies, Miamisburg, OH.

Waite, 1973a. D. A. Waite, *An Analytical Technique for Distributing Air Sampling Locations Around Nuclear Facilities,* Report Number BNWL-SA-4534, Battelle Pacific Northwest Laboratories, Richland, WA.

Waite, 1973b. D. A. Waite, *Analysis of an Analytical Technique for Distributing Air Sampling Locations Around Nuclear Facilities,* Report Number BNWL-SA-4676, Battelle Pacific Northwest Laboratories, Richland, WA.

ENVIRONMENTAL MONITORING PROGRAM SUMMARY

MEMP

Environmental Monitoring Plan Summary 2000

Media	Sampling Locations	Collection/Analysis Frequency
Effluent air	Stacks: SM/PP, T-West, T-East, HEFS, NCDPF, SW-1CN, HH, WDA, WDSS, Building 22, Building 23, CWPF	Filters Collected: weekly Analysis: monthly composite (Pu-238, Pu-239,240, U-233,234, U-238), *Additional Analyses: Th-228, Th-227, Th-232, Th-230 for SW-1CN and HEFS monthly composite.* Bubblers Collected: weekly Analyzed: weekly composite A&D, monthly composite B, C, E, & F (tritium) Note: both filters and bubblers are not present on all stacks; specific radionuclides are monitored if their presence in the building or ductwork can reasonably be expected to lead to an air emission Non-radiological: in accordance with PTOs (mass balance approach)
Arterials	D-3, D-4, D-5, D-6, T-6, T-7, T-8, SMPI, SMPE, NW-T, NW-48	Collected : daily Analyzed: daily (gross alpha, tritium)
Effluent water	601, 602, 002, 003	Collected: daily Analyzed: daily (gross alpha, tritium), 2-week composite (Pu-238, Pu-239,240, U-233,234, U-238, Th-228, Th-230, Th-232). Increased Th analysis frequency per OEPA request through Core team. Non-radiological: in accordance with NPDES permit and Authorization to Discharge
Ambient air	8 onsite sampling stations (211, 212, 213, 214, 215, 216, 217, 218) 12 offsite sampling stations (101, 102, 103, 104, 105, 111, 112, 115, 118, 119, 124, CLN) Note: supplemental particulate sampling height (2 meter) maintained at station 215	Filters Collected: weekly Analyzed: weekly (mass loading), monthly composite for 8 onsite locations and 3 offsite locations 104, 124, and CLN (Pu-238, Pu-239,240), quarterly composite for others (Pu-238, Pu-239,240); additional analysis of monthly composite for 6 locations 213, 215, 216, 218, 119, and 124 (Th-228, Th-230, and Th-232) Bubblers Collected: weekly (tritium) Analyzed: weekly (tritium)

MEMP

Environmental Monitoring Plan Summary 2000

Media	Sampling Locations	Collection/Analysis Frequency
Surface water	6 locations in the Great Miami River (R-2, R-4, R-5, R-6, R-7, and R-8) and 1 local stream (Mound Ave Storm)	Great Miami River Collected: monthly (tritium, Pu-238, Pu-239,240, U-233,234, U-238) Analyzed: monthly (tritium, Pu-238, Pu-239,240, U-233,234, U-238), quarterly (Th-228, Th-230, Th-232) Mound Ave Storm Collected: monthly Analyzed: monthly (tritium, gross, alpha)
	7 ponds (P-11, P-12, P-14, P-15, P-17, P-18, BG)	Collected: annually Analyzed: annually (tritium, Pu-238, Pu-239,240)
Sediment	14 locations corresponding with Great Miami River, Mound Avenue Storm, and pond locations	Collected: Great Miami River and Mound Ave Storm quarterly, ponds annually Analyzed: at sampling frequency (Pu-238, Pu-239,240, Th-228, Th-230, Th-232)
Foodstuffs	Centerville, Springboro, Germantown, Miamisburg, Eaton an/or Tipp City, West Carrollton, Miami Township	Collected: annually Analyzed: annually C root crops (Pu-238, Pu-239,240) C tomatoes (tritium) Note: locations and types of produce vary based on availability
Groundwater	Onsite production wells and potable water distribution system	In accordance with OAC
	Onsite production wells (0071, 0271, 0076)	Collected: weekly Analyzed: weekly (tritium), monthly (Pu-238, Pu-239,240, U-233,234, U-238), quarterly (Th-228, Th-230, Th-232)
	Offsite production & private wells: 0904 (J-1), 0905 (Tr-1), 0906 (B-R), 0907 (B-H), 0909 (MCD)	Collected: monthly Analyzed: monthly (tritium) Note: frequency of sample collection from private wells varies based on seasonal availability of water
Groundwater	Community water supplies: Franklin, Germantown,	Collected: monthly Analyzed: monthly tritium for all locations; Miamisburg and Tipp City also monthly

Media	Sampling Locations	Collection/Analysis Frequency
	Miamisburg, Middletown, Springboro, West Carrollton, Tipp City	Pu-238, Pu-239,240, U-233,234, U-238 and quarterly Th-228, Th-230, Th-230
	Offsite monitoring wells: 0127, 0128, 0303, 0376, 0383, 0377, 0388	Collected: quarterly (0127, 0128, 0303, 0376, 0383, 0377, 0388), semi-annually (0303, 0376, 0383, 0377, 0388) Analyzed: quarterly (tritium), semi-annually (Pu-238, Pu-239,240, U-233,234, U-238, Th-228, Th-230, Th-232)
	Seeps: 0601 (S001), 0607 (S007)	Collected: daily samples via auto-sampler collected weekly Analyzed: daily samples analyzed each week (tritium, gross alpha)