APPENDIX E

DOSE ASSESSMENT METHODOLOGY

E.1 Exposure Routes

Members of the public receive radiation doses via various exposure pathways. For radionuclides discharged to the atmosphere, a person may inhale or be immersed in airborne radionuclides. Other routes of airborne exposure include ground deposition of radionuclides and consumption of food products that were contaminated by airborne releases. For radionuclides released to water, a person may consume contaminated water or fish. The other potential water-based exposure pathways (e.g., swimming and boating) generally do not add significantly to the dose.

E.2 Dose Calculations Based on Measured Data

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 for MEMP is the sum of the CEDEs from the air, drinking water, and foodstuff pathways.

CEDEs for tritium, plutonium-238, plutonium-239,240, thorium-228, and thorium-230 were calculated for 2000. (Concentrations of other radionuclides were below background levels or were too small to affect the overall dose.) The CEDEs are evaluated using environmental monitoring data measured on and near the site. A CEDE for a given radionuclide is calculated as shown below. Specific input values for 2000 are shown in Table E-1. The CEDEs for all radionuclides are then summed to provide a single value for reporting purposes.

$$CEDE = \sum_{1}^{p} C_r \bullet I_a \bullet DCF$$

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.

Table E-1. Factors Used to Calculate 2000 CEDEs

Radionuclide	Concentration[a]	Location*	Dose Conversion Factor, mrem/ μCi
Tritium			
Air	3.51×10^{-12} μCi/mL	213	6.3×10^{-2} (a)
Drinking water	0.16×10^{-6} μCi/mL	Miamisburg	6.3×10^{-2}
Foodstuffs	0.05×10^{-6} μCi/mL	Miamisburg	6.3×10^{-2}
Plutonium-238			
Air	8.0×10^{-18} μCi/mL	213	3.8×10^{5} (b)
Drinking water	ND	Miamisburg	ND
Foodstuffs	ND	Miamisburg	ND
Plutonium-239,240			
Air	ND	213	ND
Drinking water	ND	Miamisburg	ND
Foodstuffs	0.01×10^{-9} μCi/g	Miamisburg	2.18×10^{3} (b)
Thorium-228			
Air	7.43×10^{-18} μCi/mL	213	3.1×10^{5}
Drinking Water	ND	Miamisburg	ND
Foodstuffs	NA		
Thorium-230			
Air	9.02×10^{-18} μCi/mL	213	3.2×10^{5}
Drinking Water	0.003×10^{-9} μCi/mL	Miamisburg	5.3×10^{2}
Foodstuffs	NA		
Thorium-232			
Air	6.6×10^{-18} μCi/mL	213	1.6×10^{6}
Drinking Water	ND	Miamisburg	ND
Foodstuffs	NA		

[a] Represents the average radionuclide concentrations in air corresponding to the location of the maximum offsite dose, average incremental radionuclide concentrations from the Miamisburg water supply, and average produce concentrations from the Miamisburg area.

ND = concentrations not detectable above the environmental level or reagent blanks.

NA = not applicable (not measured).

* Air sampling locations shown on Figure 4-4.

Annual Intake Rates:

Air	8400 m^3
Drinking water	730 L
Foodstuffs	260 kg

(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 MEMP 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 dose factors are averages of Class W and Class Y values.

E.3 Dose Calculations for NESHAPs Compliance

To demonstrate compliance with the requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs, 40 CFR 61, Subpart H), MEMP performs additional dose calculations each year for all airborne releases. As approved by the EPA, the computer code CAP88-PC is used to calculate those doses.

The CAP88-PC computer model is a set of computer programs, databases, and associated utility programs for estimation of dose and risk from radionuclide emissions to air. CAP88-PC was developed by the U.S. EPA to demonstrate compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) or radionuclides under 40 CFR Part 61, Subpart H.

Whenever available, MEMP uses site-specific data as input to the code. Meteorological data measured onsite are used to evaluate transport and dispersion. Stack specific release rates are used as shown below (Table E-2). Table E-2 also lists the relevant stack information used for the 2000 CAP88-PC runs.

Table E-2. 2000 CAP88-PC Input Data

Stack	Stack Height (meters)	Stack Diameter (meters)	Exit velocity (meters/sec)	Radionuclide(s)	2000 Release Rate (Ci/yr)
HH	34	1.7	1.3	H-3	4.6×10^{0}
NCDPF	41	0.6	27.2	H-3	2.5×10^{1}
SM/PP	60	1.8	5.5	Pu-238	7.8×10^{-06}
				Pu-239	2.0×10^{-08}
				U-233,234	1.7×10^{-09}
				U-238	4.6×10^{-10}
SW-ICN	46	0.9	13.4	H-3	5.8×10^{0}
				Pu-238	1.3×10^{-09}
				Pu-239	1.6×10^{-10}
				U-234	3.7×10^{-10}
				U-238	2.6×10^{-10}
T-WEST	60	2.4	14.1	H-3	6.9×10^{1}
				Pu-238	3.0×10^{-07}
				Pu-239	6.4×10^{-09}
				U-234	9.7×10^{-09}
				U-238	8.0×10^{-09}
T-EAST	60	1.8	8.4	H-3	3.7×10^{-01}
HEFS	46	1.9	10.5	H-3	2.8×10^{2}
				Pu-238	3.2×10^{-08}
				Pu-239	1.0×10^{-10}
				U-234	3.1×10^{-09}
				U-238	5.1×10^{-10}
WDSS	16	0.3	12.6	Pu-238	7.7×10^{-10}
				Pu-239	9.5×10^{-12}
WDA	9	1	10.7	H-3	2.0×10^{-02}
				Pu-238	1.2×10^{-06}
				Pu-239	9.3×10^{-09}
				U-233,234	2.5×10^{-09}
				U-238	4.0×10^{-10}
BLDG 22	7	0.9	0 (a)	H-3	1.2×10^{-01}
BLDG 23	2	0.3	0 (a)	H-3	8.9×10^{-01}
BLDG 124 (CWPF)	9	0.8	11.6	H-3	1.0×10^{-02}
				Pu-238	1.6×10^{-08}
				Pu-239	4.6×10^{-10}
				U-234	1.1×10^{-09}
				U-238	1.3×10^{-09}

(a) No credit taken for exit velocity due to orientation of the building vent.