Chapter 12 Radiation Protection

12.1 Ensuring That Occupational Radiation Exposures Are ALARA

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following at the beginning of this section.

STD SUP 12.1-1

The ALARA program is addressed in Appendix 12AA and Appendix 12BB.

12.1.1.3.1 **Compliance with Regulatory Guide 8.8**

Replace the first paragraph of this section with the following.

STD COL 12.1-4-A

Compliance with Regulatory Guide 8.8 is addressed in Appendix 12AA and Appendix 12BB.

12.1.1.3.2 **Compliance with Regulatory Guide 8.10**

Replace this section with the following.

STD COL 12.1-1-A

Compliance with Regulatory Guide 8.10 is addressed in Appendix 12AA and Appendix 12BB.

12.1.1.3.3 **Compliance with Regulatory Guide 1.8**

Replace this section with the following.

STD COL 12.1-2-A

Compliance with Regulatory Guide 1.8 is addressed in Appendix 12AA and Appendix 12BB.

12.1.3 **Operational Considerations**

Replace this section with the following

STD COL 12.1-3-A

The ALARA program implementation is addressed in Appendix 12AA

and Appendix 12BB.

12.1.4 **COL Information**

12.1-1-A **Regulatory Guide 8.10**

STD COL 12.1-1-A This COL item is addressed in Subsection 12.1.1.3.2.

12.1-2-A **Regulatory Guide 1.8**

STD COL 12.1-2-A This COL item is addressed in Subsection 12.1.1.3.3.

12.1-3-A **Operational Considerations**

STD COL 12.1-3-A This COL item is addressed in Subsection 12.1.3.

12.1-4-A **Regulatory Guide 8.8**

STD COL 12.1-4-A This COL item is addressed in Subsection 12.1.1.3.1.

12.2 Plant Sources

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

EF3 DEP 11.4-1 Replace Table 12.2-22 with Table 12.2-22R.

12.2.1.5 **Other Contained Sources**

Replace this section with the following.

STD COL 12.2-4-A In addition to the contained sources identified above, additional contained sources which contain by-product, source, or special nuclear materials may be maintained onsite. These contained sources are used as calibration, check, or radiography sources. These sources are not part of the permanent plant design, and their control and use are governed by plant procedures. The procedures consider the guidance provided in RG 8.8 to ensure that occupational doses from the control and use of the sources are as low as is reasonably achievable (ALARA).

Various types and quantities of radioactive sources are employed to calibrate the process and effluent radiation monitors, the area radiation monitors, and portable and laboratory radiation detectors. Check sources that are integral to the area, process, and effluent monitors consist of small quantities of by-product material and do not require special handling, storage, or use procedures for radiation protection purposes.

The same consideration applies to solid and liquid radionuclide sources of exempt quantities or concentrations which are used to calibrate or check the portable and laboratory radiation measurement instruments.

Instrument calibrators are normally used for calibrating gamma dose rate instrumentation. These may be self-contained, heavily shielded, multiple source calibrators. Beta and alpha radiation sources are also available for instrument calibration. Calibration sources are traceable to the National Institute of Standards and Technology, or equivalent.

Radiography sources are surveyed upon entry to the site. Radiation protection personnel maintain copies of the most recent leak test records for owner-controlled sources. Contractor radiography personnel provide copies of the most recent leak test records upon radiation protection personnel request. Radiography is conducted in accordance with approved procedures.

The Condensate Storage Tank (CST) potentially contains radioactive fluids. Estimated conservative radionuclide inventories in the CST are provided in Table 12.2-207. Using conservative assumed parameters for the CST, the exposure rate is less than 5 mrem/hr at 30 cm from the CST and would not be considered a radiation area per 10 CFR 20.1003.

12.2.2.1 Airborne Releases Offsite

Replace this section with the following.

EF3 COL 12.2-2-A

Airborne sources are calculated using the source terms given in Section 11.1.

The bases for these calculations are shown in Table 12.2-15R.

The ESBWR standard design employs three ventilation stacks (airborne release points). Individual stacks service the ventilation flows from the Reactor/Fuel Buildings (RB/FB), the Turbine Building (TB) and the Radwaste Building (RWB). The offsite airborne release analysis of the ESBWR ventilation stack design employs conservative long term atmospheric dispersion (X/Q) and deposition (D/Q) parameter values for each release location. Fermi site-specific values for these parameters are shown in Table 12.2-15R.

The subject X/Q and D/Q values in Table 12.2-15R are used in the calculation of the gaseous effluent normal operation doses in Table

12.2-18bR. Calculation of site-specific doses is discussed in Subsection 12.2.2.2.

Table 12.2-15R contains values used in calculating the annual airborne release source term. The gaseous source term presented in DCD Table 12.2-16 accounts for the pumped forward design of the ESBWR feed water heaters. In a pumped-forward feed water heater configuration, a significant portion of the steam flow bypasses the condensate demineralizers, increasing the concentration of radionuclides in the reactor water and, when the methodology of NUREG-0016 is applied, increasing the concentration of radionuclides in the gaseous effluents. Gaseous effluents predicted from DCD Table 12.2-16 indicate that the resultant exposure could exceed 15 mrem to the Fermi 3 MEI critical organ during a calendar year. Based upon ANSI 18.1-1999, the gaseous effluent predicted by the NUREG-0016 methodology is overly conservative given the industry's low tolerance for fuel failures and industry wide efforts to reduce radiation exposures ALARA. Additionally, the NUREG-0016 calculated reactor water radioiodine concentrations, upon which the effluent release rates are based, are also overly conservative based upon the measured radioiodine concentrations seen at boiling water reactors, adjusting for power level, reactor water mass, and system flows consistent with DCD Section 11.1.3. In accordance with Subsection 11.5.4.5 and the Fermi 3 ODCM, methods (such as altering the feed water system valve lineup, if necessary, to secure pumped forward feed water heaters) are implemented to ensure that the estimated dose to the MEI is less than 15 mrem to the critical organ. Gaseous effluent release rates will be maintained by limiting the radioiodine concentrations in the reactor water to those prescribed in Table 12.2-205.

The radioiodine gaseous effluent estimates, consistent with NUREG-0016, are listed in Table 12.2-206. The gaseous source term presented in DCD Table 12.2-16 with the radioiodine source terms in Table 12.2-206 were utilized to calculate estimates for the dose to the MEI and population. The source term for noble gas and other fission products are provided in DCD Table 12.2-16. Design basis noble gas and other fission product concentrations are taken from the tables in DCD Chapter 11. The source term for iodine is provided in Table 12.2-206. The concentration limits of Table 12.2-205 should not present an operational issue and are consistent with the measured concentrations found in

operating boiling water reactors, adjusting for power level, reactor water mass, and system flows. Operational iodine concentrations are listed in Table 12.2-205. Specific details and information on5 the derivation of the airborne source terms are provided in DCD Appendix 12B.

Annual Releases

Based upon the above criteria, the normal operating source terms are given in DCD Table 12.2-16 and Table 12.2-206 and a comparison to 10 CFR 20 criteria is given in Table 12.2-17R. This table also shows the maximum activity concentration for each nuclide at the site boundary from combined operation of Fermi 2 and Fermi 3, and the corresponding concentration limit from 10 CFR 20, Appendix B, Table 2, Column 1.

12.2.2.2 Airborne Dose Evaluation Offsite

Replace this section with the following.

EF3 COL 12.2-2-A

The bases for the calculation of Fermi 3-specific airborne offsite doses are provided in Table 12.2-18aR. The annual gaseous pathway doses are provided in Table 12.2-18bR. The methodology in RG 1.109 was used in determining the annual airborne dose values. The bases include values that are default parameters in RG 1.109 and other values that are Fermi 3 site-specific inputs. As part of the analysis, several sensitivities were performed to account for potentially limiting combinations of atmospheric dispersion, deposition and ingestion pathways. The NNW direction provides the limiting plume dose. The NW direction at the site boundary provides the limiting dose for ground exposure. The NW direction provides the limiting dose for residents and consumption of vegetables. The WNW direction provides the limiting dose due to milk consumption. The NNW direction provides the limiting dose due to meat consumption. The limiting total dose is the sum of these individual applicable pathways. The results of the Fermi 3 gaseous pathway dose analysis are given in Table 12.2-18bR.

12.2.2.2.1 Compliance with 10 CFR 50, Appendix I, Sections II.B and II.C

Table 12.2-201 demonstrates that offsite doses due to Fermi 3 radioactive airborne effluents comply with the regulatory dose limits in 10 CFR 50, Appendix I, Sections II.B and II.C.

12.2.2.2.2 Compliance with 10 CFR 50, Appendix I, Section II.D

Population dose is determined for the gaseous effluent releases from Fermi 3 for both whole body dose and thyroid dose. The whole body dose is 6.7 person-rem/yr as shown in Table 12.2-204. The thyroid dose is 27.1 person-rem/yr. The cost-benefit analysis performed to consider gaseous radwaste augments to reduce doses due to gaseous effluents is presented in Section 11.3. Based on the results from the cost-benefit analyses, no augments are cost-beneficial. Therefore, Fermi 3 complies with 10 CFR 50, Appendix I, Section II.D.

12.2.2.2.3 Compliance with 10 CFR 20 Appendix B, Table 2, Column 1

Table 12.2-17R provides the gaseous effluent concentrations in comparison to the 10 CFR 20, Appendix B, Table 2, Column 1 limits. The Fermi 3 gaseous effluent concentrations comply with 10 CFR 20, Appendix B, Table 2, Column 1.

12.2.2.2.4 Compliance with 10 CFR 20.1301 and 20.1302

Compliance with 10 CFR 20.1301 and 20.1302 is demonstrated in Subsection 12.2.2.4.4 and 12.2.2.4.5, respectively.

12.2.2.4 Liquid Doses Offsite

Replace this section with the following.

EF3 COL 12.2-3-A

The ESBWR LWMS is designed with the capability to recycle 100 percent of the liquid radwaste (zero liquid release). The analysis of dose via liquid effluents is presented in order to provide a conservative representation of unit operation. Detroit Edison intends to operate Fermi 3 with zero liquid effluents.

Liquid pathway doses were calculated based on the criteria specified in DCD Section 12.2.2.3 for compliance with 10 CFR 50, Appendix I. Dose conversion factors and methodologies consistent with RGs 1.109 and

1.113 were used as described in DCD References 12.2-7 and 12.2-4, respectively.

The liquid effluent pathway offsite dose calculation bases are provided in Table 12.2-20aR. The bases include values that are default parameters in RG 1.109 and other values that are Fermi 3 site-specific inputs.

Based on the annual liquid release offsite values in DCD Table 12.2-19b, the Fermi 3 annual liquid release concentrations were calculated based upon the criteria specified in DCD Section 12.2.2.3 and the Fermi 3 specific input values shown in Table 12.2-20aR.

The LADTAP II code is used to perform the liquid effluent dose analysis (DCD Reference 12.2-3). The results of the dose calculation are given in Table 12.2-20bR.

12.2.2.4.1 Compliance with 10 CFR 50, Appendix I, Section II.A

Table 12.2-202 demonstrates that offsite dose due to Fermi 3 radioactive liquid effluents comply with the regulatory dose limits in 10 CFR 50, Appendix I, Section II.A.

12.2.2.4.2 Compliance with 10 CFR 50, Appendix I, Section II.D

Population dose is determined for the liquid effluent releases from Fermi 3 for both whole body dose and thyroid dose. The whole body dose is 14.9 person-rem/yr as shown in Table 12.2-204. The thyroid dose is 30.1 person-rem/yr. The cost-benefit analysis performed to consider liquid radwaste augments to reduce dose due to liquid effluents is presented in Section 11.2. Based on the above liquid effluent dose estimate values and the threshold value from the cost-benefit analysis, no augments are cost-beneficial.Therefore, Fermi 3 complies with 10 CFR 50, Appendix I, Section II.D.

12.2.2.4.3 Compliance with 10 CFR 20 Appendix B, Table 2, Column 2

Compliance with 10 CFR 20 Appendix B, Table 2, Column 2 is demonstrated in Table 12.2-19bR.

12.2.2.4.4 Compliance with 10 CFR 20.1301 and 20.1302

This section demonstrates that offsite doses due to Fermi 3, combined with offsite doses due to Fermi 2 comply with the regulatory limits in 10 CFR 20.1301 for doses to members of the public.

Using the Fermi 3-specific gaseous effluent release activities identified in Table 12.2-17R and the liquid effluent release activities identified in Table 12.2-19bR, the total annual doses to the MEI and the population resulting from Fermi 3 liquid and gaseous effluents are calculated and presented in Table 12.2-203 and Table 12.2-204, respectively.

The direct radiation contribution from operation of Fermi 3 is negligible. The direct dose contribution from Fermi 3 at two distances is provided in DCD Table 12.2-21. The annual dose of 5.93E-04 mrem/yr at 800 m (0.5 mi) is negligible. The distance to the site boundary from Fermi 3 (Reactor Building centerline) is at least 890 m (0.56 mi) and the increase in distance further reduces the low dose rate.

The total annual doses to the MEI and the population resulting from Fermi 2 liquid and gaseous effluents are provided in Table 12.2-203 and Table 12.2-204, respectively. The values shown are representative based on review of Fermi 2 annual radiological environmental reports (Reference 12.2-201).

The direct radiation contribution from operation of Fermi 2 is negligible. An evaluation of operating plants by the NRC states that:

> "…because the primary coolant of an LWR is contained in a heavily shielded area, dose rates in the vicinity of light water reactors are generally undetectable and are less than 1 mrem/year at the site boundary."

The NRC concludes that the direct radiation from normal operation results in "small contributions at site boundaries" (Reference 12.2-202, Section 4.6.1.2).

Table 12.2-203 shows that the total Fermi site doses resulting from the normal operation of Fermi 2 and Fermi 3 are well within the regulatory limits of 40 CFR 190.

Table 12.2-204 shows the whole body doses from liquid and gaseous effluents doses attributable to Fermi 3 for the population within 80 km (50 mi) from the Fermi site.

12.2.2.4.5 Compliance with 10 CFR 20.1302

Surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas are conducted to demonstrate compliance with the dose limits given in 10 CFR 20.1302 for individual members of the public.

Compliance with the annual dose limit in 10 CFR 20.1302 is demonstrated by showing that the calculated total effective dose equivalent to the individual likely to receive the highest dose does not exceed the annual dose limit.

12.2.4 COL Information

12.2-2-A Airborne Effluents and Doses

EF3 COL 12.2-2-A This COL item is addressed in Subsection 12.2.2.1 and Subsection 12.2.2.2, and Table 2.0-201.

12.2-3-A Liquid Effluents and Doses

EF3 COL 12.2-3-A This COL item is addressed in Subsection 12.2.2.4.

12.2-4-A Other Contained Sources

STD COL 12.2-4-A This COL item is addressed in Subsection 12.2.1.5.

12.2.5 References

12.2-201 Detroit Edison, “Fermi 2 – 2006 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2006 through December 31, 2006.”

12.2-202 U.S. Nuclear Regulatory Commission, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants,” NUREG-1437, May 1996.

Table 12.2-15R Airborne Sources Calculation [EF3 COL 12.2-2-A]

	Calculation Bases	
	Methodology	DCD Appendix 12B
	Noble Gas Source at t=30 min	740 MBq/sec (20,000 µCi/sec)
	I-131 Release Rate	3.7 MBq/sec (100 µCi/sec)
EF3 COL 12.2-2-A	Meteorology Boundary(1)	Table 2.3-303 and Table 2.3-304 and Table 2.3-345 and Table 2.3-346
EF3 COL 12.2-2-A	Meteorology X/Qs(1)	
	RWB Ventilation Stack	Table 2.3-326 through Table 2.3-328 and Table 2.3-366 through Table 2.3-368
	RB/FB Ventilation Stack	Table 2.3-330 through Table 2.3-332 and Table 2.3-370 through Table 2.3-372
	TB Ventilation Stack	Table 2.3-334 through Table 2.3-336 and Table 2.3-374 through Table 2.3-376
EF3 COL 12.2-2-A	Meteorology D/Qs(1)	
	RWB Ventilation Stack	Table 2.3-329 and Table 2.3-369
	RB/FB Ventilation Stack	Table 2.3-333 and Table 2.3-373
	TB Ventilation Stack	Table 2.3-337 and Table 2.3-377
	Plant Availability Factor	0.92
	Offgas System:	
	Offgas stream temperature	100°F
	Flow rate	54 m^3/hr
	K_d (Kr)	18.5 cm^3/g
	K_d (Xe)	330 cm^3/g
	K_d (Ar)	6.4 cm^3/g
	Guard tank charcoal mass	7,500 kg (single tank)
	Adsorber tank charcoal mass	27,750 kg (each)
	Adsorber tank arrangement	2 parallel trains of 4 tanks each
	Turbine Gland Sealing System Exhaust:	
	I-131 release	0.81 Ci/yr per µCi/g of I-131 in coolant
	I-133 release	0.22 Ci/yr per µCi/g of I-133 in coolant

(1) In Section 2.3.5, long-term routine release X/Q and D/Q values are determined based on meteorological data from both 1985-1989 and 2002-2007. The X/Q and D/Q values used in the airborne sources calculation are the greatest values from both time periods.

Table 12.2-17R Comparison of Airborne Release Concentrations with 10 CFR 20 Limit (Sheet 1 of 4) [EF3 COL 12.2-2.A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/m^3**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
Kr-83m	8.5E+01	2.3E-03	2.3E-06	6.3E-17	3.6E-12	5.00E-05	7.2E-08
Kr-85m	6.6E+05	1.8E+01	2.0E-02	5.3E-13	1.4E-10	1.00E-07	1.4E-03
Kr-85	5.2E+06	1.4E+02	1.6E-01	4.3E-12	2.3E-11	7.00E-07	3.3E-05
Kr-87	1.4E+06	3.9E+01	4.4E-02	1.2E-12	3.5E-12	2.00E-08	1.7E-04
Kr-88	2.1E+06	5.7E+01	6.3E-02	1.7E-12	5.5E-11	9.00E-09	6.1E-03
Kr-89	1.4E+07	3.7E+02	6.2E-01	1.7E-11	9.6E-11	1.00E-09	9.6E-02
Xe-131m	1.5E+05	4.1E+00	4.6E-03	1.2E-13	5.8E-12	2.00E-06	2.9E-06
Xe-133m	1.9E+02	5.2E-03	5.3E-06	1.4E-16	2.4E-12	6.00E-07	4.0E-06
Xe-133	4.1E+07	1.1E+03	2.8E+00	7.6E-11	1.0E-09	5.00E-07	2.1E-03
Xe-135m	2.2E+07	6.1E+02	4.5E+00	1.2E-10	1.2E-10	4.00E-08	3.0E-03
Xe-135	2.8E+07	7.5E+02	2.8E+00	7.7E-11	1.0E-10	7.00E-08	1.4E-03
Xe-137	2.8E+07	7.8E+02	1.5E+00	4.0E-11	6.3E-11	1.00E-09	6.3E-02
Xe-138	2.3E+07	6.3E+02	7.2E-01	1.9E-11	1.2E-10	2.00E-08	5.9E-03
I-131	8.7E+03	2.3E-01	3.7E-04	1.0E-14	2.1E-14	2.00E-10	1.0E-04
I-132	5.8E+04	1.6E+00	2.7E-03	7.3E-14	1.7E-13	2.00E-08	8.6E-06
I-133	4.3E+04	1.2E+00	2.0E-03	5.4E-14	1.3E-13	1.00E-09	1.3E-04
I-134	1.1E+05	2.8E+00	4.9E-03	1.3E-13	3.2E-13	6.00E-08	5.4E-06

Table 12.2-17R Comparison of Airborne Release Concentrations with 10 CFR 20 Limit (Sheet 2 of 4) [EF3 COL 12.2-2.A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/m^3**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
I-135	5.9E+04	1.6E+00	2.8E-03	7.4E-14	1.8E-13	6.00E-09	3.1E-05
H-3	2.8E+06	7.2E+01	7.7E-02	2.1E-12	2.2E-12	1.00E-07	2.2E-05
C-14	5.3E+05	1.4E+01	1.6E-02	4.4E-13	4.4E-13	3.00E-09	1.5E-04
Na-24	5.9E+00	1.6E-04	1.6E-07	4.4E-18	4.4E-18	7.00E-09	6.3E-10
P-32	1.5E+00	4.1E-05	4.1E-08	1.1E-18	1.1E-18	5.00E-10	2.2E-09
Ar-41	1.4E+03	3.8E-02	4.3E-05	1.2E-15	1.2E-15	1.00E-08	1.2E-07
Cr-51	2.7E+02	7.2E-03	1.9E-05	5.0E-16	5.0E-16	3.00E-08	1.7E-08
Mn-54	3.0E+02	8.2E-03	7.3E-05	2.0E-15	2.0E-15	1.00E-09	2.0E-06
Mn-56	1.2E+01	3.2E-04	3.3E-07	8.9E-18	8.9E-18	2.00E-08	4.5E-10
Fe-55	5.1E+01	1.4E-03	1.4E-06	3.8E-17	3.8E-17	3.00E-09	1.3E-08
Fe-59	4.1E+01	1.1E-03	6.0E-06	1.6E-16	1.6E-16	5.00E-10	3.2E-07
Co-58	8.0E+01	2.2E-03	5.6E-06	1.5E-16	1.5E-16	1.00E-09	1.5E-07
Co-60	6.6E+02	1.8E-02	1.3E-04	3.5E-15	3.5E-15	5.00E-11	7.1E-05
Ni-63	5.2E-02	1.4E-06	1.4E-09	3.9E-20	3.9E-20	1.00E-09	3.9E-11
Cu-64	7.5E+00	2.0E-04	2.1E-07	5.6E-18	5.6E-18	3.00E-08	1.9E-10
Zn-65	6.2E+02	1.7E-02	2.3E-05	6.1E-16	6.1E-16	4.00E-10	1.5E-06
Rb-89	2.0E-01	5.4E-06	5.5E-09	1.5E-19	1.5E-19	2.00E-07	7.5E-13

Table 12.2-17R Comparison of Airborne Release Concentrations with 10 CFR 20 Limit (Sheet 3 of 4) [EF3 COL 12.2-2.A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/m^3**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
Sr-89	3.1E+02	8.3E-03	9.3E-06	2.5E-16	9.0E-16	2.00E-10	4.5E-06
Sr-90	1.9E+00	5.0E-05	5.4E-08	1.5E-18	5.0E-17	6.00E-12	8.4E-06
Y-90	8.9E-02	2.4E-06	2.5E-09	6.6E-20	6.6E-20	9.00E-10	7.4E-11
Sr-91	7.5E+00	2.0E-04	2.1E-07	5.6E-18	1.4E-14	5.00E-09	2.8E-06
Sr-92	4.9E+00	1.3E-04	1.4E-07	3.7E-18	2.2E-14	9.00E-09	2.4E-06
Y-91	1.9E+00	5.1E-05	5.2E-08	1.4E-18	1.4E-18	2.00E-10	7.1E-09
Y-92	3.8E+00	1.0E-04	1.0E-07	2.8E-18	2.8E-18	1.00E-08	2.8E-10
Y-93	8.1E+00	2.2E-04	2.2E-07	6.0E-18	6.0E-18	3.00E-09	2.0E-09
Zr-95	9.2E+01	2.5E-03	1.5E-05	4.2E-16	4.2E-16	4.00E-10	1.1E-06
Nb-95	5.0E+02	1.4E-02	1.4E-05	3.8E-16	3.8E-16	2.00E-09	1.9E-07
Mo-99	3.4E+03	9.3E-02	9.5E-05	2.6E-15	7.2E-15	2.00E-09	3.6E-06
Tc-99m	2.4E+00	6.5E-05	6.6E-08	1.8E-18	5.7E-14	2.00E-07	2.9E-07
Ru-103	2.1E+02	5.8E-03	5.9E-06	1.6E-16	1.6E-16	9.00E-10	1.8E-07
Rh-103m	3.8E-03	1.0E-07	1.0E-10	2.8E-21	2.8E-21	2.00E-06	1.4E-15
Ru-106	1.6E-01	4.3E-06	4.4E-09	1.2E-19	1.2E-19	2.00E-11	6.0E-09
Rh-106	5.2E-06	1.4E-10	1.4E-13	3.9E-24	3.9E-24	1.00E-09	3.9E-15
Ag-110m	1.7E-01	4.6E-06	4.7E-09	1.3E-19	1.3E-19	1.00E-10	1.3E-09
Sb-124	1.1E+01	3.0E-04	1.4E-06	3.9E-17	3.9E-17	3.00E-10	1.3E-07
Te-129m	1.8E+00	4.9E-05	5.0E-08	1.3E-18	1.3E-18	3.00E-10	4.5E-09

Table 12.2-17R Comparison of Airborne Release Concentrations with 10 CFR 20 Limit (Sheet 4 of 4) [EF3 COL 12.2-2.A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/m^3**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
Te-131m	6.0E-01	1.6E-05	1.7E-08	4.5E-19	4.5E-19	1.00E-09	4.5E-10
Te-132	1.5E-01	4.1E-06	4.1E-09	1.1E-19	1.0E-15	9.00E-10	1.1E-06
Cs-134	3.7E+02	1.0E-02	4.9E-05	1.3E-15	1.4E-15	2.00E-10	6.8E-06
Cs-136	3.1E+01	8.3E-04	8.6E-07	2.3E-17	4.6E-17	9.00E-10	5.1E-08
Cs-137	5.5E+02	1.5E-02	8.0E-05	2.2E-15	2.2E-15	2.00E-10	1.1E-05
Cs-138	8.5E-01	2.3E-05	2.3E-08	6.3E-19	3.1E-14	8.00E-08	3.9E-07
Ba-140	1.6E+03	4.4E-02	4.6E-05	1.2E-15	3.1E-15	2.00E-09	1.6E-06
La-140	1.4E+01	3.8E-04	3.9E-07	1.0E-17	1.0E-17	2.00E-09	5.2E-09
Ce-141	5.5E+02	1.5E-02	1.7E-05	4.5E-16	4.6E-16	8.00E-10	5.7E-07
Ce-144	1.6E-01	4.3E-06	4.4E-09	1.2E-19	7.3E-18	2.00E-11	3.7E-07
Pr-144	1.8E-04	4.9E-09	5.0E-12	1.3E-22	1.3E-22	2.00E-07	6.7E-16
W-187	1.4E+00	3.8E-05	3.9E-08	1.0E-18	1.0E-18	1.00E-08	1.0E-10
Np-239	9.0E+01	2.4E-03	2.5E-06	6.7E-17	4.9E-14	3.00E-09	1.6E-05
Total_(w/H-3)	1.7E+08	4.6E+03	1.3E+01	3.6E-10	1.8E-09		1.8E-01
Total_(w/oH-3)	1.7E+08	4.5E+03	1.3E+01	3.6E-10	1.8E-09		1.8E-01

Table 12.2-18aR Offsite Dose Calculation Bases [EF3 COL 12.2-2-A]

	Calculation Bases	
EF3 COL 12.2-2-A	Meteorology χ/Qs	Table 12.2-15R
EF3 COL 12.2-2-A	Meteorology D/Qs	Table 12.2-15R
	Airborne Release Source Term	DCD Table 12.2-16 and Table 12.2-206
	Calculation Methodology	RG 1.109
	Computer Code Utilized	GASPAR II (NUREG/CR-4653)
	Individual Consumption Rates	Table E-5 of RG 1.109
	Misc. Calculation Inputs (other than RG 1.109 default values):	
EF3 COL 12.2-2-A	Midpoint of plant operating life	20 years
EF3 COL 12.2-2-A	Fraction of year that leafy vegetables are grown	0.33
EF3 COL 12.2-2-A	Fraction of year that animals graze on pasture	0.58 for milk cows 0.67 for goats
EF3 COL 12.2-2-A	Fraction of daily feed that is pasture grass when the animal grazes on pasture	1 for cows 1 for goats
	Animal milk considered for milk pathway	Cow and Goat
EF3 COL 12.2-2-A	Annual Average Doses from Airborne Releases	Table 12.2-18bR

Table 12.2-18bR Gaseous Pathway Doses to the MEI (Sheet 1 of 5) [EF3 COL 12.2-2-A]

Location	Pathway	Annual Dose (mrem/yr)			
		Total Body	Thyroid	Bone	Skin
Site Boundary (769 m [0.48 mi] NNW)	**Plume**	1.42E-01	1.42E-01	1.42E-01	3.35E-01
Site Boundary (769 m [0.48 mi] NW)	**Radioiodines and Particulates:**				
	Ground	6.96E-01	6.96E-01	6.96E-01	8.16E-01
	Inhalation				
	Adult	3.88E-03	2.43E-01	2.44E-03	1.49E-03
	Teen	3.70E-03	3.16E-01	3.38E-03	1.50E-03
	Child	2.94E-03	3.85E-01	4.53E-03	1.33E-03
	Infant	1.69E-03	3.51E-01	3.06E-03	7.63E-04
	Total (Iodine & Particulates)				
	Adult	7.00E-01	9.39E-01	6.98E-01	8.17E-01
	Teen	7.00E-01	1.01E+00	6.99E-01	8.18E-01
	Child	6.99E-01	1.08E+00	7.01E-01	8.17E-01
	Infant	6.98E-01	1.05E+00	6.99E-01	8.17E-01

Table 12.2-18bR Gaseous Pathway Doses to the MEI (Sheet 2 of 5) [EF3 COL 12.2-2-A]

Location	Pathway	Annual Dose (mrem/yr)			
		Total Body	Thyroid	Bone	Skin
Residence (957 m [0.59 mi]) + Garden (960 m [0.60] mi NW)	**Radioiodines and Particulates:**				
	Ground	4.95E-01	4.95E-01	4.95E-01	5.81E-01
	Vegetable				
	Adult	1.73E-01	3.89E+00	4.18E-01	5.38E-02
	Teen	2.07E-01	5.41E+00	6.96E-01	9.03E-02
	Child	3.37E-01	1.05E+01	1.68E+00	2.20E-01
	Inhalation				
	Adult	2.81E-03	1.85E-01	1.74E-03	1.14E-03
	Teen	2.72E-03	2.40E-01	2.41E-03	1.16E-03
	Child	2.23E-03	2.93E-01	3.23E-03	1.02E-03
	Infant	1.29E-03	2.68E-01	2.20E-03	5.87E-04
	Total (Iodine & Particulates)				
	Adult	6.71E-01	4.57E+00	9.15E-01	6.36E-01
	Teen	7.05E-01	6.15E+00	1.19E+00	6.72E-01
	Child	8.34E-01	1.13E+01	2.18E+00	8.02E-01
	Infant	4.96E-01	7.63E-01	4.97E-01	5.82E-01

Table 12.2-18bR Gaseous Pathway Doses to the MEI (Sheet 3 of 5) [EF3 COL 12.2-2-A]

Location	Pathway	Annual Dose (mrem/yr)			
		Total Body	Thyroid	Bone	Skin
Meat Cow (4754 m [2.95 mi] NNW)	**Radioiodines and Particulates:**				
	Ground	1.07E-02	1.07E-02	1.07E-02	1.26E-02
	Cow Meat				
	Adult	1.61E-03	4.93E-03	6.67E-03	1.29E-03
	Teen	1.27E-03	3.72E-03	5.62E-03	1.09E-03
	Child	2.22E-03	6.02E-03	1.05E-02	2.05E-03
	Inhalation				
	Adult	1.31E-04	8.69E-03	6.62E-05	7.40E-05
	Teen	1.32E-04	1.13E-02	9.16E-05	7.46E-05
	Child	1.14E-04	1.37E-02	1.23E-04	6.59E-05
	Infant	6.68E-05	1.25E-02	8.54E-05	3.79E-05
	Total (Iodine & Particulates)				
	Adult	1.25E-02	2.43E-02	1.75E-02	1.39E-02
	Teen	1.21E-02	2.57E-02	1.64E-02	1.37E-02
	Child	1.31E-02	3.04E-02	2.13E-02	1.47E-02
	Infant	1.08E-02	2.32E-02	1.08E-02	1.26E-02

Table 12.2-18bR Gaseous Pathway Doses to the MEI (Sheet 4 of 5) [EF3 COL 12.2-2-A]

Location	Pathway	Annual Dose (mrem/yr)			
		Total Body	Thyroid	Bone	Skin
Milk Cow (3363 m [2.09 mi] WNW)	**Radioiodines and Particulates:**				
	Ground	2.90E-02	2.90E-02	2.90E-02	3.40E-02
	Cow Milk				
	Adult	8.56E-03	2.84E-01	1.76E-02	2.53E-03
	Teen	1.13E-02	4.52E-01	3.22E-02	4.64E-03
	Child	1.86E-02	9.00E-01	7.80E-02	1.13E-02
	Infant	3.28E-02	2.18E+00	1.46E-01	2.37E-02
	Inhalation				
	Adult	2.41E-04	1.61E-02	1.26E-04	1.31E-04
	Teen	2.42E-04	2.09E-02	1.74E-04	1.32E-04
	Child	2.08E-04	2.55E-02	2.32E-04	1.17E-04
	Infant	1.23E-04	2.32E-02	1.62E-04	6.71E-05
	Total (Iodine & Particulates)				
	Adult	3.78E-02	3.30E-01	4.67E-02	3.67E-02
	Teen	4.05E-02	5.01E-01	6.13E-02	3.88E-02
	Child	4.78E-02	9.55E-01	1.07E-01	4.54E-02
	Infant	6.19E-02	2.24E+00	1.76E-01	5.77E-02

Table 12.2-18bR Gaseous Pathway Doses to the MEI (Sheet 5 of 5) [EF3 COL 12.2-2-A]

Location	Pathway	Annual Dose (mrem/yr)			
		Total Body	Thyroid	Bone	Skin
Milk Goat (3554 m [2.21 mi] WNW)	**Radioiodines and Particulates:**				
	Ground	2.57E-02	2.57E-02	2.57E-02	3.01E-02
	Goat Milk				
	Adult	1.68E-02	3.48E-01	2.38E-02	2.39E-03
	Teen	1.86E-02	5.53E-01	4.32E-02	4.34E-03
	Child	2.24E-02	1.10E+00	1.05E-01	1.05E-02
	Infant	3.48E-02	2.67E+00	1.88E-01	2.19E-02
	Inhalation				
	Adult	2.17E-04	1.45E-02	1.12E-04	1.20E-04
	Teen	2.19E-04	1.88E-02	1.54E-04	1.21E-04
	Child	1.89E-04	2.30E-02	2.07E-04	1.07E-04
	Infant	1.11E-04	2.10E-02	1.44E-04	6.17E-05
	Total (Iodine & Particulates)				
	Adult	4.27E-02	3.88E-01	4.96E-02	3.26E-02
	Teen	4.45E-02	5.98E-01	6.91E-02	3.46E-02
	Child	4.83E-02	1.15E+00	1.30E-01	4.07E-02
	Infant	6.06E-02	2.72E+00	2.14E-01	5.21E-02

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit (Sheet 1 of 3) [EF3 COL 12.2-3-A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/ml**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
1-131	1.55E+02	4.19E-03	6.4E-06	1.73E-10	2.09E-10	1.00E-06	2.09E-04
1-132	3.03E+01	8.18E-04	1.25E-06	3.38E-11	2.19E-10	1.00E-04	2.19E-06
1-133	7.77E+02	2.10E-02	3.21E-05	8.68E-10	1.29E-09	7.00E-06	1.84E-04
1-134	1.48E+00	4.00E-05	6.12E-08	1.65E-12	1.20E-10	4.00E-04	3.00E-07
1-135	2.00E+02	5.40E-03	8.27E-06	2.23E-10	5.30E-10	3.00E-05	1.77E-05
H-3	5.18E+05	1.40E+01	2.14E-02	5.78E-07	1.01E-06	1.00E-03	1.01E-03
Na-24	1.89E+02	5.10E-03	7.82E-06	2.11E-10	2.85E-10	5.00E-05	5.70E-06
P-32	1.55E+01	4.19E-04	6.41E-07	1.73E-11	1.91E-11	9.00E-06	2.12E-06
Cr-51	4.81E+02	1.30E-02	1.99E-05	5.37E-10	5.93E-10	5.00E-04	1.19E-06
Mn-54	5.92E+00	1.60E-04	2.45E-07	6.61E-12	7.25E-12	3.00E-05	2.42E-07
Mn-56	4.81E+01	1.30E-03	1.99E-06	5.37E-11	2.16E-10	7.00E-05	3.08E-06
Fe-55	8.51E+01	2.30E-03	3.52E-06	9.50E-11	1.04E-10	1.00E-04	1.04E-06
Fe-59	2.59E+00	6.99E-05	1.07E-07	2.89E-12	3.21E-12	1.00E-05	3.21E-07
Co-58	1.63E+01	4.40E-04	6.74E-07	1.82E-11	2.00E-11	2.00E-05	9.99E-07
Co-60	3.33E+01	8.99E-04	1.38E-06	3.72E-11	4.09E-11	3.00E-06	1.36E-05
Cu-64	4.81E+02	1.30E-02	1.99E-05	5.37E-10	7.51E-10	2.00E-04	3.76E-06
Zn-65	1.67E+01	4.51E-04	6.91E-07	1.86E-11	2.04E-11	5.00E-06	4.08E-06
Zn-69m	3.40E+01	9.18E-04	1.41E-06	3.80E-11	5.26E-11	6.00E-05	8.77E-07

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit (Sheet 2 of 3) [EF3 COL 12.2-3-A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/ml**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
Br-83	3.33E+00	8.99E-05	1.38E-07	3.72E-12	2.30E-11	9.00E-04	2.56E-08
Sr-89	8.14E+00	2.20E-04	3.37E-07	9.09E-12	1.01E-11	8.00E-06	1.26E-06
Sr-90	7.40E-01	2.00E-05	3.06E-08	8.26E-13	8.26E-13	5.00E-07	1.65E-06
Sr-91	4.44E+01	1.20E-03	1.84E-06	4.96E-11	7.58E-11	2.00E-05	3.79E-06
Y-91	5.18E+00	1.40E-04	2.14E-07	5.78E-12	6.11E-12	8.00E-06	7.63E-07
Sr-92	1.07E+01	2.89E-04	4.43E-07	1.19E-11	4.56E-11	4.00E-05	1.14E-06
Y-92	4.07E+01	1.10E-03	1.68E-06	4.55E-11	9.02E-11	4.00E-05	2.25E-06
Y-93	4.44E+01	1.20E-03	1.84E-06	4.96E-11	7.64E-11	2.00E-05	3.82E-06
Zr-95	7.40E-01	2.00E-05	3.06E-08	8.26E-13	8.26E-13	2.00E-05	4.13E-08
Nb-95	7.40E-01	2.00E-05	3.06E-08	8.26E-13	8.26E-13	3.00E-05	2.75E-08
Mo-99	1.11E+02	3.00E-03	4.59E-06	1.24E-10	1.41E-10	2.00E-05	7.07E-06
Tc-99m	2.04E+02	5.51E-03	8.44E-06	2.28E-10	3.43E-10	1.00E-03	3.43E-07
Ru-103	1.48E+00	4.00E-05	6.12E-08	1.65E-12	1.81E-12	3.00E-05	6.05E-08
Ru-105	6.29E+00	1.70E-04	2.60E-07	7.02E-12	1.64E-11	7.00E-05	2.34E-07
Te-129m	3.33E+00	8.99E-05	1.38E-07	3.72E-12	4.04E-12	7.00E-06	5.77E-07
Te-131m	3.70E+00	9.99E-05	1.53E-07	4.13E-12	4.94E-12	8.00E-06	6.17E-07
Te-132	7.40E-01	2.00E-05	3.06E-08	8.26E-13	8.26E-13	9.00E-06	9.18E-08
Cs-134	2.52E+01	6.80E-04	1.04E-06	2.81E-11	3.10E-11	9.00E-07	3.45E-05

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit (Sheet 3 of 3) [EF3 COL 12.2-3-A]

	Fermi 3 Annual Release		Fermi 3 Concentration		Fermi 2 + 3 Concentration	10 CFR 20 Concentration Limit	Fermi 2 + 3 Fraction of 10 CFR 20 Limit
Nuclide	**MBq/yr**	**Ci/yr**	**Bq/ml**	**µCi/ml**	**µCi/ml**	**µCi/ml**	
Cs-136	1.52E+01	4.10E-04	6.29E-07	1.70E-11	2.44E-11	6.00E-06	4.06E-06
Cs-137	6.66E+01	1.80E-03	2.75E-06	7.44E-11	7.61E-11	1.00E-06	7.61E-05
Ba-139	1.48E+00	4.00E-05	6.12E-08	1.65E-12	2.00E-11	2.00E-04	9.99E-08
Ba-140	3.03E+01	8.18E-04	1.25E-06	3.38E-11	3.75E-11	8.00E-06	4.69E-06
Ce-141	2.59E+00	6.99E-05	1.07E-07	2.89E-12	3.21E-12	3.00E-05	1.07E-07
La-142	1.11E+00	3.00E-05	4.59E-08	1.24E-12	1.28E-11	1.00E-04	1.28E-07
Ce-143	1.11E+00	3.00E-05	4.59E-08	1.24E-12	1.40E-12	2.00E-05	7.00E-08
Pr-143	3.33E+00	8.99E-05	1.38E-07	3.72E-12	4.04E-12	2.00E-05	2.02E-07
W-187	8.88E+00	2.40E-04	3.67E-07	9.92E-12	1.23E-11	3.00E-05	4.11E-07
Np-239	4.07E+02	1.10E-02	1.68E-05	4.55E-10	5.16E-10	2.00E-05	2.58E-05
Total (wi/H-3)	5.22E+05	1.41E+01	2.16E-02	5.83E-07	1.02E-06		1.63E-03
Total (w/oH-3}	3.62E+03	9.79E-02	1.50E-04	4.05E-09	6.06E-09		6.21E-04

Table 12.2-20aR Liquid Pathway Offsite Dose Calculation Bases [EF3 COL 12.2-3-A]

	Calculation Bases	
	Calculation Methodology	RG 1.109
	Computer Code Utilized	LADTAP II (NUREG/CR-4013)
	Individual Consumption/Exposure Rates	Table E-5 of RG 1.109
	Site Water Type	Freshwater
EF3 COL 12.2-3-A	Liquid Effluent Discharge Rate	400 liters/min (0.234 ft^3/sec)
EF3 COL 12.2-3-A	Shore-Width Factor	0.3
EF3 COL 12.2-3-A	Dilution Factor	115 – Minimum to discharge location (1) Additional dilution factors after discharge: 45 – Nearest Shoreline Northeast (1770 m [1.1 mi]) 67 – Nearest Shoreline South (1530 m [0.95 mi]) 77 – 3200 m (1.99 mi) South 100 – Distances greater than 3200 m (1.99 mi)
EF3 COL 12.2-3-A	Transit times from discharge to the receiving water body to exposure location	Drinking Water – 22.6 hours Fishing – 24 hours Aquatic Recreation – 10.6 hours
EF3 COL 12.2-3-A	Irrigation rate	None – lake water is not used for irrigation
EF3 COL 12.2-3-A	Fraction of year that leafy vegetables are grown	Not used in liquid pathway dose calculation
EF3 COL 12.2-3-A	Fraction of year that animals graze on pasture	Not used in liquid pathway dose calculation
EF3 COL 12.2-3-A	Fraction of daily feed that is pasture grass when the animal grazes on pasture	Not used in liquid pathway dose calculation
EF3 COL 12.2-3-A	Animal milk considered for milk pathway	Not used in liquid pathway dose calculation
EF3 COL 12.2-3-A	Liquid Pathway Offsite Annual Doses	Table 12.2-20bR

Notes:

1. Blowdown flowrate divided by discharge flow rate

Table 12.2-20bR Liquid Pathway Doses from Fermi 3 for MEI at Lake Erie

[EF3 COL 12.2-3-A]

	Fermi 3 Dose (mrem/yr)		
Pathway	**Whole Body**	**Thyroid**	**Bone**
Fish	5.41E-03	2.19E-03	8.27E-02
Invertebrate	5.71E-04	1.88E-04	4.49E-03
Drinking	6.05E-04	2.63E-02	5.92E-04
Shoreline (includes water recreation)	1.01E-04	1.01E-04	1.01E-04
Total	6.48E-03	2.63E-02	8.77E-02
Age group receiving maximum dose	Adult	Infant	Child

Notes:

1. Bone of the child is the organ receiving the maximum dose.
2. There are no infant doses for the fish and invertebrate pathways because infants do not consume these foods.
3. 1 mrem = 0.01 mSv

Table 12.2-22R Radiation Source Parameters (Sheet 1 of 3)

[EF3 DEP 11.4-1]

Component	Room	Assumed Shielding Source						
		Source Approx Geometry Rt. Cylinder (r, l)		Source Characteristic				Quantity
		Length (m)	Radius (m)	Type	Material	Density (g/cm^3)	Equipment Self-Shielding	
RWCU/SDC (RB)								
Non regenerative Heat Exchanger	1151/1250						Steel 2cm thick	Three
Tube side	1161/1260	7.00	0.16	Homogeneous	Water	0.967		
Regenerative Heat Exchanger	1151/1250						Steel 2cm thick	Two
Tube side	1161/1260	7.00	0.16	Homogeneous	Water	0.836		
Shell side		7.00	0.25	Homogeneous	Water	0.990		
Demineralizer	1251/52/61/62	4.12	0.48	Homogeneous	Resins	0.69	Steel 1cm thick	Four
FAPCS (FB)								
Heat Exchanger	2150/2160	0.96	0.30	Homogeneous	Water	1.00	Steel 2cm thick	Two
Filter / Demineralizer	2251/2261	2.06	1.12	Homogeneous	Resins	0.69	Steel 1cm thick	Two
Backwash Receiving Tank	2102	1.00	0.56	Homogeneous	Water	1.00	Steel 1cm thick	One
OFF-GAS System (TB)								
Steam Jet Air Ejectors	4206/4207			Homogeneous	Offgas	5.95E-05	Steel 1cm thick	Two
Preheater/Recombiner/Condenser	4381/4382	$10.45 m^3$		Homogeneous	Offgas	6.5E-04	Steel 1cm thick	Two
Cooler Condenser	4381/4382	$0.12 m^3$		Homogeneous	Offgas	1.04E-03	Steel 1cm thick	Two

Table 12.2-22R Radiation Source Parameters (Sheet 2 of 3)

[EF3 DEP 11.4-1]

Component	Room	Assumed Shielding Source						
		Source Approx Geometry Rt. Cylinder (r, l)		Source Characteristic				Quantity
		Length (m)	Radius (m)	Type	Material	Density (g/cm^3)	Equipment Self-Shielding	
Dryer		5.81 m^3		Homogeneous	Offgas	1.02E-03	Steel 1cm thick	Two
Guard Bed	4108	1.4	2.1	Homogeneous	Offgas	1.02E-03	Steel 1cm thick	Two
Delay Bed	4108	7.5	1.5	Homogeneous	Offgas	1.02E-03	Steel 1cm thick	Eight
CPS (TB)								
Condensate Demineralizer	42F1A to F1H	0.92	1.75	Homogeneous	Resins	0.69	Steel 2cm thick	Eight
Turbine Condenser (TB)								
Main Condenser	4186							Three (Bodies)
Shell		1284 m^3		Homogeneous	Water	7.21E-04	Steel 1cm thick	
Well		2136 m^3		Homogeneous	Water	1	Steel 1cm thick	
LWMS (RW)								
Equipment Drain Collection Tank	6103/4/5	140 m^3		Homogeneous	Water	1	Steel 1cm thick	Three
Floor Drain Collection Tank	6150/6160	130 m^3		Homogeneous	Water	1	Steel 1cm thick	Two
Chemical Drain Collection Tank	6201	4 m^3		Homogeneous	Water	1	Steel 1cm thick	One
Detergent Drain Collection Tank	6282	15 m^3		Homogeneous	Water	1	Steel 1cm thick	Two
Equipment Drain Sample Tank	6171	140 m^3		Homogeneous	Water	1	Steel 1cm thick	Two
Floor Drain Sample Tank	6171	130 m^3		Homogeneous	Water	1	Steel 1cm thick	Two
Detergent Drain Sample Tank	6282	15 m^3		Homogeneous	Water	1	Steel 1cm thick	Two

Table 12.2-22R Radiation Source Parameters (Sheet 3 of 3)

[EF3 DEP 11.4-1]

Component	Room	Assumed Shielding Source						
		Source Approx Geometry Rt. Cylinder (r, l)		Source Characteristic				Quantity
		Length (m)	Radius (m)	Type	Material	Density (g/cm^3)	Equipment Self-Shielding	
SWMS (RW)								
High Activity Resin Holdup Tank	6108	3.26	2.00	Homogeneous	Resins	0.69	Steel 1cm thick	One
Low Activity Resin Holdup Tank	6106	0.48	2.00	Homogeneous	Water	0.69	Steel 1cm thick	One
High/Low Activity Phase Separator Room	6251/6161	0.48	2.00	Homogeneous	Water	1.00	Steel 1cm thick	Two
Condensate Resin Holdup Tank	6107	2.70	2.00	Homogeneous	Resins	0.69	Steel 1cm thick	One
Concentrate Waste Tank	6109	3.98	2.00	Homogeneous	Water	1.03	Steel 1cm thick	One

1 m = 3.28 ft, 1 m^3 = 35.3 ft^3

Table 12.2-201 Comparison of Annual Doses to the MEI from Gaseous Effluents

[EF3 COL 12.2-2-A]

Type of Dose	Location	Fermi 3	10 CFR 50 Limit
Gamma Air (mrad/yr)	Site Boundary (769 m [0.48 mi] NNW)	2.18E-01	10
Beta Air (mrad/yr)	Site Boundary (769 m [0.48 mi] NNW)	2.59E-01	20
Whole Body (mrem/yr) [Includes Plume Exposure]	Table 12.2-18bR	9.76E-01	5
Skin (mrem/yr) [Includes Plume Exposure]	Table 12.2-18bR	1.15E+00	15
Iodines and Particulates – Max Organ Thyroid (mrem/yr)	Table 12.2-18bR	1.13E+01	15

1 mrad = 0.01 mGy
1 mrem = 0.01 mSv

Table 12.2-202 Comparison of Annual Doses to MEI from Liquid Effluents

[EF3 COL 12.2-3-A]

Type of Dose	Location	Fermi 3	10 CFR 50 Limit
Whole Body (mrem/yr)	Lake Erie	6.48E-03	3
Thyroid (mrem/yr)	Lake Erie	2.63E-02	10
Bone (mrem/yr)	Lake Erie	8.77E-02	10

1 mrem = 0.01 mSv

Table 12.2-203 Comparison of Site Doses to the MEI

[EF3 COL 12.2-2-A] [EF3 COL 12.2-3-A]

Type of Dose	Fermi 3 (ESBWR)			Fermi 2	Site Total(1)	40 CFR 190 Limit
	Liquid	Gaseous	Total			
Whole Body (mrem/yr)	0.006	0.976	0.98	4.68	5.66	25
Thyroid (mrem/yr)	0.026	11.3	11.33	2.66	13.99	75
Bone (mrem/yr)	0.088	2.18	2.27	0.052	2.32	25

Notes:

1. This site total dose includes the Fermi 3 total dose and the dose from Fermi 2.
2. 1 mrem = 0.01 mSv

Table 12.2-204 Collective Total Body (Population) Doses Within 50 Miles [EF3 COL 12.2-2-A] [EF3 COL 12.2-3-A]

Units in person-rem/yr

	Fermi 3
Total Body (Liquid)	14.9
Bone (Liquid)	104.2
Thyroid (Liquid)	30.1
Total Body (Gaseous)	6.7
Max Organ – Thyroid (Gaseous)	27.1

1 rem = 0.01 Sv

Table 12.2-205 Fermi 3 Normal Operational Iodine Radioisotopes in Reactor Water (Based on Fermi 3 ODCM) [EF3 COL 12.2-2-A]

Isotope	Decay Constant	Water Concentration	
		(MBq/gm)	µCi/gm)
I-131	3.59E-03	5.6E-05	1.5E-03
I-132	3.03E-01	5.3E-04	1.4E-02
I-133	3.33E-02	3.8E-04	1.0E-02
I-134	7.91E-01	9.7E-04	2.6E-02
I-135	1.05E-01	5.5E-04	1.5E-02

Table 12.2-206 Fermi 3 Annual Airborne Iodine Releases for Offsite Dose Evaluations (MBq)** - Based on Reactor Water Iodine Concentrations in Table 12.2-205 [EF3 COL 12.2-2-A]

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
I-131	9.4E+02	5.2E+03	3.4E+02	1.8E+03	4.7E+01		3.4E+02
I-132	8.5E+03	4.6E+04	3.0E+03				4.9E+01
I-133	6.2E+03	3.4E+04	2.2E+03		8.4E+01		3.3E+02
I-134	1.5E+04	8.4E+04	5.5E+03				3.4E+01
I-135	8.6E+03	4.7E+04	3.1E+03				1.4E+02

** The releases (as designated in the table column headings) from the building stacks are as follows:

Reactor Building/Fuel Building stack: “Reactor Building” and “Drywell”

Turbine Building stack: “Turbine Building”, “Mechanical Vacuum Pump”, “Turbine Seal”, and “Offgas System”

Radwaste Building stack: “Radwaste Building”

Table 12.2-207 Bounding Radionuclide Concentration and Inventory in the Condensate Storage Tank (Sheet 1 of 2) [STD COL 12.2-4-A]

Radionuclide	CST Source Term Concentration	CST Source Term Inventory
	µCi/cc	Curies
H-3	1.0E-02	4.89E+01
I-131	5.5E-05	2.70E-01
I-132	3.9E-04	1.92E+00
I-133	3.6E-04	1.76E+00
I-134	6.0E-04	2.95E+00
I-135	4.8E-04	2.33E+00
Rb-89	2.7E-06	1.31E-02
Sr-89	4.1E-06	2.02E-02
Sr-90	6.6E-07	3.23E-03
Y-90	1.2E-08	5.77E-05
Sr-91	2.7E-06	1.31E-02
Sr-92	6.1E-06	3.00E-02
Y-91	2.8E-08	1.36E-04
Y-92	3.8E-06	1.84E-02
Y-93	2.7E-06	1.31E-02
Zr-95	5.5E-09	2.71E-05
Nb-95	5.5E-09	2.71E-05
Mo-99	3.6E-06	1.74E-02
Tc-99m	1.4E-06	6.78E-03
Ru-103	1.4E-08	6.78E-05
Rh-103m	1.4E-08	6.78E-05
Ru-106	2.1E-09	1.02E-05
Rh-106	2.1E-09	1.02E-05
Te-129m	1.2E-06	5.97E-03
Te-131m	6.8E-08	3.34E-04
Te-132	2.3E-08	1.10E-04
Cs-134	2.2E-05	1.07E-01
Cs-136	1.9E-06	9.37E-03
Cs-137	6.2E-05	3.04E-01

Table 12.2-207 Bounding Radionuclide Concentration and Inventory in the Condensate Storage Tank (Sheet 2 of 2) [STD COL 12.2-4-A]

Radionuclide	CST Source Term Concentration	CST Source Term Inventory
	µCi/cc	Curies
Ba-137m	5.1E-08	2.47E-04
Cs-138	5.4E-06	2.62E-02
Ba-140	4.6E-06	2.26E-02
La-140	2.8E-07	1.36E-03
Ce-141	2.1E-08	1.02E-04
Ce-144	2.1E-09	1.02E-05
Pr-144	2.1E-09	1.02E-05
Np-239	1.1E-05	5.49E-02
Na-24	1.4E-06	6.78E-03
P-32	2.8E-08	1.36E-04
Cr-51	2.1E-06	1.02E-02
Mn-54	2.5E-08	1.21E-04
Mn-56	1.5E-05	7.26E-02
Fe-55	6.9E-07	3.39E-03
Fe-59	2.1E-08	1.02E-04
Co-58	6.9E-08	3.39E-04
Co-60	1.4E-07	6.78E-04
Ni-63	6.9E-10	3.39E-06
Cu-64	2.0E-06	9.68E-03
Zn-65	6.9E-07	3.39E-03
Ag-110m	6.9E-10	3.39E-06
W-187	2.1E-07	1.02E-03

12.3 Radiation Protection

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

EF3 DEP 11.4-1

Insert the following at the begining of this section.

As described in Section 11.4, the Radwaste Building has been configured to accommodate increased storage capacity of Class B and C solid waste. Specifically, the waste storage capacity of the Radwaste Building Class B and C waste has been increased to approximately 10 years.

As part of the configuration changes to the Radwaste Building, the following DCD Tables and Figures are replaced by site specific Tables and Figures.

- Table 12.3-4R replaces DCD Table 12.3-4
- Table 12.3-8R replaces DCD Table 12.3-8
- Figure 12.3-19R through Figure 12.3-22R replace DCD Figures 12.3-19 through 12.3-22
- Figure 12.3-39R through Figure 12.3-42R replace DCD Figures 12.3-39 through 12.3-42
- Figure 12.3-61R through Figure 12.3-64R replace DCD Figures 12.3-61 through 12.3-64

Equipment locations were revised to provide an enhanced arrangement. However; tank sizes, tank contents and source terms are the same as those reflected in the DCD. The thicknesses for Radwaste Building walls presented in departure Table 12.3-8R were evaluated against those same walls in DCD Table 12.3-8 and revised if necessary to maintain the same radiation zones as those identified in the DCD. As such, radiation levels and required shielding will remain the same regardless of tank location.

A qualitative evaluation of each wall in the Radwaste Building was performed. The evaluation consisted of comparing the thickness and function of a wall in the departure (FSAR Table 12.3-8R) to the same wall in the DCD. If the value in Table 12.3-8R was equal to or greater than that shown in DCD Table 12.3-8, the value in Table 12.3-8R is more conservative and no further evaluation is required. If the value in Table 12.3-8R is less than that shown in the DCD table, then the function of the

wall was identified and the thickness was compared to the corresponding function in the DCD, the departure wall thickness was updated as needed. In this manner, the radiation zones in the departure were maintained the same as those in the DCD.

12.3.1.4.5 **Radwaste Building**

Add the following two bullet items at the end of the bulleted list of the first paragraph.

EF3 SUP 12.3-1

- Provision for control of fluids exiting high activity rooms, including provision to isolate floor drains, and remote operation of control valves from the RW control room.
- Piping from high activity rooms are arranged to minimize exposure to normally occupied areas, and are designed to maintain radiation levels in the RWB process system area as shown in Figure 12.3-19R through Figure 12.3-22R.

12.3.1.5 **Minimization of Contamination and Radioactive Waste Generation**

STD COL 12.3-4-A

Replace the second sentence in the second paragraph with the following.

Subsection 12.3.1.5.2 describes operational procedures and program concepts associated with the Regulatory Position.

12.3.1.5.1 **Design Considerations**

Add the following after the bullets in the third paragraph:

There are no other underground piping segments at Fermi 3 that require features to minimize contamination or monitoring to ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment is minimized.

12.3.1.5.2 **Operational/Programmatic Considerations**

Replace this section with the following.

STD COL 12.3-4-A

Programs and procedures are implemented consistent with NEI 08-08A (Reference 12.3-201), "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," to meet the post-construction and operational objectives of Regulatory Guide 4.21 and the requirements of 10 CFR 20.1406. These objectives include:

- Operational practices are periodically reviewed to ensure operating procedures reflect the installation of new or modified equipment, personnel qualification and training are kept current, and facility personnel are following the operating procedures.
- Future decommissioning is facilitated by maintenance of records relating to facility design and construction, facility design changes, site conditions before and after construction, onsite waste disposal and contamination and results of radiological surveys.
- A conceptual site model (based on site characterization and facility design and construction) that aids in the understanding of the interface with environmental systems and the features that control the movement of contamination in the environment is maintained.
- The final site configuration will be evaluated after construction to assist in preventing the migration of radionuclides offsite via unmonitored pathways.
- An onsite contamination monitoring program is implemented along the potential pathways from the release sources to the receptor points. Measures are implemented in operating procedures to minimize contamination. Appendix 12BB establishes contamination control measures to ensure compliance with 10 CFR 20.1406. Practical measures to prevent the spread of contamination are employed, including:
  - Engineering controls, such as portable ventilation or filtration units to reduce concentrations of radioactivity in air or fluids, are used where practical.
  - Criteria for selecting tools, material, and equipment for use in contaminated areas include minimizing the use of porous or other materials that are difficult to decontaminate.
  - Leaks and spills are contained promptly and repaired or cleaned up as soon as practical.

- Containments, caches, and enclosures are used during maintenance, repairs, and testing, when practical, to contain spills or releases.
- Contaminated tools and equipment are segregated from clean tools and equipment .
- Potentially contaminated systems, equipment, and components are surveyed for the presence of contamination when opened or prior to removal.
- Procedures ensure that equipment performs and is operated in accordance with the design requirements.
- Temporary and permanent design modifications require compensatory measures be taken to prevent and limit the spread of contamination.

12.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

Replace the last bullet with the following.

STD COL 12.3-2-A

The radiation instrumentation that monitors airborne radioactivity is classified as nonsafety-related. Airborne radiation monitoring operational considerations, such as the procedures for operation and calibration of the monitors, as well as the placement of the portable monitors, are discussed in Section 12.5.

12.3.7 COL Information

12.3-2-A Operational Considerations

STD COL 12.3-2-A

This COL item is addressed in Subsection 12.3.4.

12.3-4-A Compliance with 10 CFR 20.1406

STD COL 12.3-4-A

This COL item is addressed in Subsection 12.3.1.5.2.

12.3.8 References

12.3-201 Nuclear Energy Institute, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination, NEI 08-08A.

Table 12.3-4R Area Radiation Monitors for Radwaste Building [EF3 DEP 11.4-1]

ARM No.	Description & Location	Figure No.	Monitoring Range1
1	RW Electrical Equipment Room (6170), EL -9350	12.3-39R	H
2	RW Control Room (6270), EL -2350	12.3-40R	H
3	RW High Activity Decant Pump Room (6188), EL -9350	12.3-39R	H
4	RW High Activity Transfer Pump Room (6283), EL-2350	12.3-40R	H
5	RW Trailer Access Area (6383), EL 4650	12.3-41R	H
6[2]	RW Liquid Radioactive Waste Treatment Processing Systems Area (6381), EL 4650	12.3-41R	H
7[2]	RW Wet Solid Radioactive Waste Treatment Processing Area (6394/6395), EL 4650	12.3-41R	H
8[2]	RW Dry Solid Waste Treatment Area (Sorting Room 6393), EL 4650	12.3-41R	H
9[2]	RW Packaged Waste Storage Area (6390/6391/6392), EL 4650	12.3-41R	H

[1] The monitoring ranges corresponding to these alphabetical designations are provided in DCD Table 12.3-7.

[2] ARMs located in accessible areas where abnormal plant evolutions or anticipated operational occurrences can potentially result in dose rate increases of 1mSv/hr (100 mrem/hr) or more.

Table 12.3-8R Shielding Geometry (Nominal) (Sheet 1 of 3) [EF3 DEP 11.4-1]

Elev.	Room	Room Name	North	East	South	West	Floor	Ceiling
Nuclear Island			**cm (in)**					
-11500	1151	RWCU/SDC Heat Exchanger Room A	75 (30)	110 (43)	100 (39)	100/75 (39/30)	Ground	70 (28)
-11500	1152	RWCU/SDC Pump Room A	60 (24)	55 (22)	55 (22)	60/40 (24/16)	Ground	110 (43)
-11500	1161	RWCU/SDC Heat Exchanger Room B	75 (30)	100 (39)	100/75 (39/30)	110 (43)	Ground	70 (28)
-11500	1162	RWCU/SDC Pump Room B	60 (24)	60 (24)	70 (28)	35 (14)	Ground	70 (28)
-11500	2102	FAPC Backwash Tank Room	70 (28)	80 (31)	90 (35)	Exterior Below Grade	Ground	90 (35)
-11500	2150	FAPC Pump/Heat Exchanger Room A	35 (14)	70 (28)	Exterior Below Grade	30 (12)	Ground	70 (28)
-11500	2151	Backwash Transfer Pump Room A	90 (35)	105 (41)	70 (28)	Exterior Below Grade	Ground	70 (28)
-11500	2160	FAPC Pump/Heat Exchanger Room B	35 (14)	30 (12)	Exterior Below Grade	35 (14)	Ground	70 (28)
-11500	2161	Backwash Transfer Pump Room B	70 (28)	105 (41)	70 (28)	Exterior Below Grade	Ground	70 (28)
-6400	1250	RWCU/SDC Heat Exchanger Room A	110(43)	110 (43)	100 (39)	100 (39)	70 (28)	70 (28)
-6400	1251	RWCU/SDC Filter/Demineralizer Vault A1	135 (53)	150 (59)	80 (31)	135 (53)	110 (43)	110 (43)
-6400	1252	RWCU/SDC Filter/Demineralizer Vault A2	80 (31)	150 (59)	80 (31)	135 (53)	110 (43)	110 (43)
-6400	1260	RWCU/SDC Heat Exchanger Room B	110(43)	100 (39)	100 (39)	100 (39)	70 (28)	70 (28)
-6400	1261	RWCU/SDC Filter/Demineralizer Vault B1	135(53)	110 (43)	150 (59)	100 (39)	110 (43)	110 (43)
-6400	1262	RWCU/SDC Filter/Demineralizer Vault B2	135(53)	110 (43)	150 (59)	100 (39)	110 (43)	110 (43)
-6400	2251	FAPC Filter/Demineralizer Vault 1	90 (35)	80 (31)	60 (24)	90 (35)	80 (31)	80 (31)
-6400	2261	FAPC Filter/Demineralizer Vault 2	60 (24)	80 (31)	Exterior Below Grade	90 (35)	80 (31)	80 (31)
Radwaste Building			**cm (in)**					
-9350	6103	Equipment Drain Collection Tank Room A	120 (47)	90 (35)	80 (31)	60 (24)	Ground	91 (36)

Table 12.3-8R Shielding Geometry (Nominal) (Sheet 2 of 3) [EF3 DEP 11.4-1]

Elev.	Room	Room Name	North	East	South	West	Floor	Ceiling
-9350	6104	Equipment Drain Collection Tank Room B	120 (47)	60 (24)	80 (31)	60 (24)	Ground	91 (36)
-9350	6105	Equipment Drain Collection Tank Room C	120 (47)	60 (24)	80 (31)	60 (24)	Ground	91 (36)
-9350	6106	Low Activity Resin Holdup Tank Room	60 (24)	60 (24)	130 (51)	60 (24)	Ground	91 (36)
-9350	6107	Condensate Resin Holdup Tank Room	60 (24)	90 (35)	130 (51)	60 (24)	Ground	91 (36)
-9350	6108	High Activity Resin Holdup Tank Room	110 (43)	100 (39)	130 (51)	110 (43)	Ground	91 (36)
-9350	6109	Concentrated Waste Tank Room	60 (24)	60 (24)	130 (51)	90 (35)	Ground	91 (36)
-9350	6150	Floor Drain Collection Tank Room A	120 (47)	60 (24)	80 (31)	60 (24)	Ground	91 (36)
-9350	6160	Floor Drain Collection Tank Room B	120 (47)	60 (24)	80 (31)	60 (24)	Ground	91 (36)
-9350	6161	Low Activity Phase Separator Room	60 (24)	70 (28)	130 (51)	60 (24)	Ground	91 (36)
-9350	6171	Floor & Equipment Drain Sample Tank Room	120 (47)	60 (24)	60 (24)	120 (47)	Ground	91 (36)
-2350	6103	Equipment Drain Collection Tank Room A	120 (47)	90 (35)	80 (31)	60 (24)	N/A	91 (36)
-2350	6104	Equipment Drain Collection Tank Room B	120 (47)	60 (24)	80 (31)	60 (24)	N/A	91 (36)
-2350	6105	Equipment Drain Collection Tank Room C	120 (47)	60 (24)	80 (31)	60 (24)	N/A	91 (36)
-2350	6106	Low Activity Resin Holdup Tank Room	60 (24)	60 (24)	130 (51)	60 (24)	N/A	91 (36)
-2350	6107	Condensate Resin Holdup Tank Room	60 (24)	90 (35)	130 (51)	60 (24)	N/A	91 (36)
-2350	6108	High Activity Resin Holdup Tank Room	110 (43)	100 (39)	130 (51)	110 (43)	N/A	91 (36)
-2350	6109	Concentrated Waste Tank Room	60 (24)	60 (24)	130 (51)	90 (35)	N/A	91 (36)
-2350	6150	Floor Drain Collection Tank Room A	120 (47)	60 (24)	80 (31)	60 (24)	N/A	91 (36)
-2350	6251	High Activity Phase Separator Room	100 (39)	100 (39)	90 (35)	100 (39)	90 (35)	91 (36)
-2350	6160	Floor Drain Collection Tank Room B	120 (47)	60 (24)	80 (31)	60 (24)	N/A	91 (36)
-2350	6161	Low Activity Phase Separator Room	60 (24)	70 (28)	130 (51)	60 (24)	N/A	91 (36)
-2350	6171	Floor & Equipment Drain Sample Tank Room	120 (47)	60 (24)	60 (24)	120 (47)	N/A	91 (36)
Turbine Building								
-1400	4196	Off-Gas Charcoal Absorber Vessel Vault	150 (59)	150 (59)	120 (47)	120 (47)	Ground	-
-1400	4197	Main Condenser Vault	110 (43)	110 (43)	70 (28)	120 (47)	Ground	
-1400	4182A	Condensate Pleated Filter Vault A	50 (20)	60 (24)	50 (20)	110 (43)	Ground	100 (39)
-1400	4182B-E	Condensate Pleated Filter Vault B-E	50 (20)	60 (24)	50 (20)	110 (43)	Ground	100 (39)
-1400	4182F	Condensate Pleated Filter Vault F	50 (20)	60 (24)	55 (22)	110 (43)	Ground	100 (39)
Turbine Building (continued)			**cm (in)**					
-1400	4183	Condensate Filter Backwash Receiving Tank Vault	60 (24)	65 (26)	85 (33)	95 (37)	Ground	100 (39)

Table 12.3-8R Shielding Geometry (Nominal) (Sheet 3 of 3) [EF3 DEP 11.4-1]

Elev.	Room	Room Name	North	East	South	West	Floor	Ceiling
-1400	4180	Condensate Demin. Resin Receiving Tank Vault	100 (39)	100 (39)	80 (31)	90 (35)	Ground	100 (39)
4650	4206B	Condensate Drain Tank and Steam Jet Air Ejector/H2 Recombiner & Cooler Room B	150 (59)	150 (59)	120 (47)	150 (59)	100 (39)	120 (47)
4650	4206A	Steam Jet Air Ejector/H2 Recombiner & Cooler Room A	120 (47)	150 (59)	120 (47)	150 (59)	100 (39)	120 (47)
4650	4281A	Condensate Deep Bed Demineralizer Vault A	35 (14)	90 (35)	35 (14)	60 (24)	100 (39)	100 (39)
4650	4281B-G	Condensate Deep Bed Demineralizer Vault B-G	35 (14)	90 (35)	35 (14)	60 (24)	100 (39)	100 (39)
4650	4281H	Condensate Deep Bed Demineralizer Vault H	35 (14)	90 (35)	90 (35)	60 (24)	100 (39)	100 (39)
12000	4301A	Feedwater Heater 5A and 6A Room	155 (61)	155 (61)	155 (61)	100 (39)	155 (61)	100 (39)
12000	4301B	Feedwater Heater 5B and 6B Room	155 (61)	155 (61)	155 (61)	100 (39)	155 (61)	100 (39)
12000	4391	Turbine Building Steam Tunnel	150 (59)	150 (59)	150 (59)	150 (59)	-	
20000	4402A	Feedwater Heater 7A Room	155 (61)	155 (61)	155 (61)	110 (43)	155 (45)	100 (39)
20000	4402B	Feedwater Heater 7B Room	155 (61)	155 (61)	155 (61)	110 (43)	155 (45)	100 (39)
28000	4504	Feedwater Heater 4 and Feedwater Storage Tank Room	150 (59)	150 (59)	150 (59)	110 (43)	115 (45)	115 (45)
28000	4505	Moisture Separator and Reheater/HP and LP Turbine Room	150 (59)	110 (43)	150 (59)	150 (59)	110 (43)	150 (59)

Figure 12.3-19R RADWASTE BUILDING RADIATION ZONES EL –9350

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-20R RADWASTE BUILDING RADIATION ZONES EL –2350

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-21R RADWASTE BUILDING RADIATION ZONES EL 4650

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-22R RADWASTE BUILDING RADIATION ZONES EL 10650

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-39R RADWASTE BUILDING AREA RADIATION MONITORS EL -9350

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-40R RADWASTE BUILDING AREA RADIATION MONITORS EL -2350

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-41R RADWASTE BUILDING AREA RADIATION MONITORS EL 4650

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-42R RADWASTE BUILDING AREA RADIATION MONITORS EL 10650

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-61R RADWASTE BUILDING ACCESS AND EGRESS ROUTES EL –9350

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-62R RADWASTE BUILDING ACCESS AND EGRESS ROUTES EL –2350

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-63R RADWASTE BUILDING ACCESS AND EGRESS ROUTES EL 4650

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

Figure 12.3-64R RADWASTE BUILDING ACCESS AND EGRESS ROUTES EL 10650

[EF3 DEP 11.4-1]

{{{Security-Related Information – Withheld Under 10 CFR 2.390}}} See Fermi 3 COLA Part 9

12.4 Dose Assessment

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.4.7.1 Annual Doses to Construction Workers

EF3 SUP 12.4-1

During the construction of Fermi 3, workers could be exposed to several potential sources of radiation. This section identifies the potential sources of radiation and estimates the doses that workers may receive during the construction of Fermi 3 due to the operation of Fermi 2.

Three types of sources are considered: direct radiation, gaseous effluents, and liquid effluents. Tables 12.4-203 and 12.4-204 provide a comparison of these calculated doses and show that the limits in 10 CFR 20.1301 and 40 CFR 190 for members of the public are satisfied.

Dose rates at the construction site are estimated based on dose rate measurements and calculations. Although construction workers will occupy a large area over the course of the construction period, dose rates to an individual construction worker are conservatively estimated based on the assumption that the worker is closest to all radiation sources without respect to the actual proximity of the sources relative to each other. The bases, assumptions and methods used to calculate the construction worker dose is given below with the maximum annual dose to an individual construction worker of 96.6 mrem/yr.

Construction workers are considered to be members of the public and radiological monitoring is handled per requirements of the Fermi 2 Radiological Effluent Monitoring Program (REMP). The Fermi site will be continually monitored during the construction period under the Fermi 2 REMP and appropriate actions taken to ensure that doses to the construction workers remain ALARA.

Direct Radiation

The direct radiation dose rates from Fermi 2 are based on an average of the highest annual measurement at the two TLD stations that are closest to the Fermi 3 power block area relative to Fermi 2 from 1999 to 2008, T-47 and T-48. This 10 year period provides sufficient data to be representative of plant conditions. The dose measured by these TLDs includes background radiation, the analysis presented accounts for background radiation as estimated using remote TLD data. In determining the direct radiation dose rates, it is assumed that the worker is located in the area between the two TLD stations for the entire year. Given that workers move about the construction area over the course of a year, and that all Fermi 3 structures are located farther than TLD station

T-48, the use of the average of the two TLD stations is a conservative selection for determining the maximum individual construction worker dose. The maximum estimated total body dose rate to a Fermi 3 construction worker due to operation of Fermi 2 is 56.3 mrem/yr. Further, no credit is taken for any shielding provided as structures are constructed.

Depending on the construction schedule for Fermi 3, a potential source of direct radiation could be an independent spent fuel storage installation (ISFSI) constructed for Fermi 2. The ISFSI dose contribution to a Fermi 3 construction worker is calculated at a distance of 820 feet from the ISFSI pad for an exposure period of 2080 hours. The distance of 820 feet is based on the closest Fermi 3 structures. The estimated dose for a 2080 hour exposure period at a distance of 820 feet from the ISFSI pad is approximately 13.8 mrem/yr.

Fermi 1 will be decommissioned before the construction of Fermi 3. In accordance with the limits established in 10 CFR 20.1402, the dose from Fermi 1 can not exceed 25 mrem/yr. It is expected that the dose from Fermi 1 will be significantly less than 25 mrem/yr.

Gaseous Effluents

The Fermi 2 Annual Radioactive Effluent Release and Radiological Environmental Operating Reports for 1999 through 2008 (Reference 12.4-201 through Reference 12.4-211) provide both the airborne effluent doses for the most highly exposed individual living near the plant, as well as the maximum potential dose to a visitor to Fermi 2 due to all radioactive effluents, including noble gases. Due to the proximity of this location to the expected Fermi 3 construction site, the dose rates due to gaseous effluents calculated at the Visitor's Center are representative of the dose rates to which the construction workers would be exposed. The annual doses at the Visitor's Center were calculated based on an exposure time of 4 hours/year. Dividing these annual doses by four results in an hourly dose rate which is representative of what a construction worker could expect to receive, and can then be used to extrapolate the dose rate to construction workers on an annual basis (2080 hours) due to gaseous effluent from Fermi 2. Using this dose rate, the maximum exposed organ (thyroid) dose of 10.4 mrem/yr and a maximum whole body dose of 1.6 mrem/yr for the annual dose from Fermi 2 gaseous releases.

Liquid Effluents

Liquid radioactive effluents from Fermi 2 may be released to Lake Erie via the circulating water reservoir blowdown line. However, there have been no liquid radioactive effluent releases from Fermi 2 since 1994

(Reference 12.4-211). As such, the dose estimate from liquid effluents is negligible.

Table 12.4-201 provides a summary of the maximum annual dose to a construction worker by source. Table 12.4-202 provides a summary of the collective annual construction worker dose. Table 12.4-203 provides a comparison of the maximum construction worker dose with the dose to the public limits in 10 CFR 20.1301. Table 12.4-204 provides a comparison of the construction worker dose from gaseous effluent discharges with the public dose limits in 40 CFR 190. Table 12.4-205 provides a comparison with the 10 CFR 50 Appendix I criteria for effluent doses. The direct radiation estimates do not take credit for shielding provided by any intervening Fermi 3 structures during construction or for activities that occur below grade. The direct radiation dose estimates also assume that the doses are not reduced as the distance from the source increases. The conservative assumptions for the direct radiation doses allow for assurance that the dose to individual construction workers is in compliance with 10 CFR 20 Subpart D. The Fermi 2 REMP will monitor radiation at the site to confirm dose to construction workers is in compliance with 10 CFR 20 Subpart D.

12.4.9 References

12.4-201 Detroit Edison, “Fermi 2 – 1999 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 1999 through December 31, 1999.”

12.4-202 Detroit Edison, "Fermi 2 – 2000 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2000 through December 31, 2000.”

12.4-203 Detroit Edison, “Fermi 2 – 2001 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2001 through December 31, 2001.”

12.4-204 Detroit Edison, “Fermi 2 – 2002 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2002 through December 31, 2002.”

12.4-205 Detroit Edison, “Fermi 2 – 2003 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2003 through December 31, 2003.”

12.4-206 Detroit Edison, “Fermi 2 – 2004 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2004 through December 31, 2004.”

12.4-207 Detroit Edison, “Fermi 2 – 2005 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2005 through December 31, 2005.”

12.4-208 Detroit Edison, “Fermi 2 – 2006 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2006 through December 31, 2006.”

12.4-209 Detroit Edison, “Fermi 2 - 2007 Annual Radioactive Effluent Release and Radiological Environmental Operating Report for the period of January 1, 2007 through December 31, 2007.”

12.4-210 Detroit Edison, “Fermi 2 - 2008 Annual Radiological Environmental Operating Report for the period of January 1, 2008 through December 31, 2008.”

12.4-211 Detroit Edison, “Fermi 2 - 2008 Annual Radioactive Effluent Release Report for the period of January 1, 2008 through December 31, 2008.”

Table 12.4-201 Maximum Annual Dose to a Construction Worker by Source (mrem)

[EF3 SUP 12.4-1]

	Direct Fermi 2	Direct ISFSI	Fermi 1	Gaseous	Liquid	Total[1]
Critical Organ	-	-	-	10.4	N/A	10.4
Whole Body	56.3	13.8	25	1.6	N/A	96.6

Notes:

1. The Total dose calculation for Whole Body exposure may not match the sum of the individual dose values due to rounding.
2. 1 mrem = 0.01 mSv

Table 12.4-202 Collective Annual Construction Worker Dose by Source (person-rem)[1]

[EF3 SUP 12.4-1]

	Direct Fermi 2	Direct ISFSI	Fermi 1	Gaseous	Liquid	Total[1]
Whole Body	163.2	39.9	72.5	4.5	N/A	280

Notes:

1. The collective annual doses are based on 2900 worker working 2080 hours.
2. 1 mrem = 0.01 mSv

Table 12.4-203 Comparison of Construction Worker Dose to Public Dose Limits Specified in 10 CF 20.1301

[EF3 SUP 12.4-1]

Type of Dose	Annual Dose Limits	Construction Worker Dose
Total effective dose equivalent per year	100 mrem	96.6 mrem
Maximum dose in any hour	2 mrem	0.128 mrem

Notes:

1. 1 mrem = 0.01 mSv

Table 12.4-204 Comparison of Construction Worker Dose from Gaseous Effluent to Public Dose Limits Specified in 40 CFR 190[1] [EF3 SUP 12.4-1]

Type of Dose	Annual Dose Limits	Construction Worker Dose
Whole body dose	25 mrem	1.6 mrem
Thyroid body dose[2]	75 mrem	10.4 mrem

Notes:

1. 10 CFR 20 requires that the dose to an individual from radioactive effluents also meet 40 CFR 190 limits.
2. The thyroid dose is identified as the maximum exposed organ; therefore the other organ dose would be less than the thyroid dose.
3. 1 mrem = 0.01 mSv

Table 12.4-205 Comparison with 10 CFR 50 Appendix I Criteria for Effluent Dose [EF3 SUP 12.4-1]

	Annual Dose (mrem) Annual Limit	Estimated Dose
Whole body dose from liquid effluents	3	Negligible[1]
Organ dose from liquid effluents	10	Negligible[1]
Whole body dose from liquid effluents	5	1.6
Organ dose from all effluents	15	10.4

Notes:

1. Per Reference 12.4-211, there have been no liquid effluent releases at Fermi 2 since 1994.
2. 1 mrem = 0.01 mSv

12.5 Operational Radiation Protection Program

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.5.3 Operational Considerations

Replace this section with the following.

The operational program for radiation protection is addressed in Appendix 12BB.

NEI report no. NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)" provides additional operating policy and consideration guidance for developing and implementing an ALARA program. As described in Appendix 12AA, NEI 07-08A is incorporated by reference.

12.5.4 COL Information

12.5-1-A Equipment, Instrumentation, and Facilities

STD COL 12.5-1-A This COL item is addressed in Appendix 12BB.

12.5-2-A Compliance with 10 CFR 50.34(f)(2)(xxvii) and NUREG-0737 Item III.D.3.3

STD COL 12.5-2-A This COL item is addressed in Appendix 12BB.

12.5-3-A Radiation Protection Program

STD COL 12.5-3-A This COL item is addressed in Appendix 12BB.

Appendix 12A Calculation of Airborne Radionuclides

This section of the referenced DCD is incorporated by reference with no departures or supplements.

Appendix 12B Calculation of Airborne Releases

This section of the referenced DCD is incorporated by reference with no departures or supplements.

STD SUP 12.1-1

Appendix 12AA ALARA Program

NEI 07-08A, Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA), is incorporated by reference with the following supplemental information. (Reference 12AA-201)

12.1.2 **Regulatory Compliance**

Replace the bracketed text in the first paragraph with Section 17.5.

12AA.1 **References**

12AA-201 Nuclear Energy Institute (NEI), Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA), NEI 07-08A.

STD COL 12.1-1-A
STD COL 12.1-2-A
STD COL 12.1-3-A
STD COL 12.1-4-A
STD COL 12.5-1-A
STD COL 12.5-2-A
STD COL 12.5-3-A

Appendix 12BB Radiation Protection

NEI 07-03A, Generic FSAR Template Guidance for Radiation Protection Program Description is incorporated by reference with the following supplemental information. (Reference 12BB-201)

12.5.2.4 **Radiation Protection Technicians**

Delete the third paragraph.

12.5.3.1 **Facilities**

Delete the first and second paragraphs.

12.5.3.2 **Monitoring Instrumentation and Equipment**

Delete the third paragraph.

12.5.3.3 **Personal Protective Clothing and Equipment**

Delete the second paragraph.

12.5.4.2 **Methods to Maintain Exposures ALARA**

Delete the second paragraph.

12.5.4.4 **Access Control**

Replace the third paragraph with the following.

Table 12BB-201 identifies the Very High Radiation Areas (VHRA). The areas identified are only VHRA during the conditions specified in the

table. It is anticipated that these areas are seldom if ever accessed when in a VHRA condition. In the unlikely event that access is required, entry into a VHRA is controlled in accordance with the requirements of a specific (Special) radiation work permit.

With the reactor at power, the containment upper and lower drywells are VHRA and administrative procedures prohibit personnel access. Drywells can only be accessed via airlocks. Opening an airlock causes an MCR alarm, further protecting personnel from accidental exposure.

DCD Sections 9.1.4.12 and 12.3.1.4.4 identify access controls for areas immediately adjacent to the IFTS. Barriers to these areas are verified via ITAAC as identified in DCD Tier 1 Table 2.5.10-1.

12.5.4.12 **Quality Assurance**

Replace the bracketed text in the first paragraph with Section 17.5.

12BB.1 **References**

12BB-201 Nuclear Energy Institute (NEI), Generic FSAR Template Guidance for Radiation Protection Program Description, NEI 07-03A.

Table 12BB-201 Very High Radiation Areas (VHRA)[1] [STD COL 12.5-3-A]

Zone	VHRA Name	VHRA Condition	DCD Drawings
1170	Lower Drywell	During power operation	12.3-1, 12.3-2, 12.3-3, 12.3-4, 12.3-10, 12.3-11
1570	Upper Drywell	During power operation	12.3-5, 12.3-6, 12.3-7, 12.3-10, 12.3-11
1702	Inclined Fuel Transfer Tube Room	During spent fuel transfer	12.3-7, 12.3-10
	Other areas adjacent to Inclined Fuel Transfer Tube	During spent fuel transfer	12.3-10

Notes:

1. Table shows dry areas only. Other areas identified as VHRA in DCD Section 12.3 drawings are submerged areas in the vicinity of spent fuel.