The Detroit Edison Company
One Energy Plaza, Detroit, MI 48226-1279

DTE Energy
Detroit Edison

**SECURITY-RELATED INFORMATION
WITHHOLD UNDER 10 CFR 2.390**

10 CFR 51.45
10 CFR 52.77
10 CFR 52.79

October 19, 2010
NRC3-10-0046

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

References: 1) Fermi 3
Docket No. 52-033
2) Letter from Jerry Hale (NRC) to Jack M. Davis (Detroit Edison), "Request for Additional Information Letter No. 42 Related to the SRP Section 12.03-04, 14.03.03 and 02.04013 for the Fermi 3 Combined License Application," dated June 30, 2010
3) Letter from Jerry Hale (NRC) to Jack M. Davis (Detroit Edison), "Request for Additional Information Letter No. 40 Related to the SRP Section Sections 2.4.13, 2.5.4, 3.2.1, 3.2.2 and 13.6.6 for the Fermi 3 Combined License Application," dated August 10, 2010

Subject: Detroit Edison Company Response to NRC Requests for Additional Information (RAI) Letter No. 42 and RAI 02.04.13-11 of Letter No. 40

In Reference 2 and 3, the NRC requested additional information to support the review of certain portions of the Fermi 3 Combined License Application (COLA). The responses to the Request for Additional Information (RAI) associated with Reference 2, SRP Sections 12.03-04, 14.03.03 and 02.04.13 are provided as Attachment 1 through 5 of this letter. Attachment 4 includes a combined response to RAI 02.04.13-11 of Reference 3 and RAI 02.04.13-12 of Reference 2. Information contained in these responses will be incorporated into a future COLA submission as described in the attachments.

If you have any questions, or need additional information, please contact me at (313) 235-3341.

D095
NRO

I state under penalty of perjury that the foregoing is true and correct. Executed on the 19th day of October 2010.

Sincerely,

Peter W. Smith, Director
Nuclear Development – Licensing & Engineering
Detroit Edison Company

Attachments:
1) Response to RAI Letter No. 42, RAI Question No. 12.03-12.04-6
2) Response to RAI Letter No. 42, RAI Question No. 12.03-12.04-8
3) Response to RAI Letter No. 42, RAI Question No. 14.03.03-1
4) Response to RAI Letter No. 42, RAI Question No. 02.04.13-12 and Response to RAI Letter No. 40, RAI Question No. 02.04.13-11
5) Response to RAI Letter No. 42, RAI Question No. 12.03-12.04-7, Enclosure 1, "Fermi 3 COLA Part 9 Markups, SUNSI"

cc: Jerry Hale, NRC Fermi 3 Project Manager
Adrian Muniz, NRC Fermi 3 Project Manager
Bruce Olson, NRC Fermi 3 Environmental Project Manager
Fermi 2 Resident Inspector (w/o attachments)
NRC Region III Regional Administrator (w/o attachments)
NRC Region II Regional Administrator (w/o attachments)
Supervisor, Electric Operators, Michigan Public Service Commission (w/o attachments)
Michigan Department of Natural Resources & Environment, Radiological Protection Section (w/o attachments)

Attachment 1
NRC3-10-0046

Response to RAI Letter No. 42
(eRAI Tracking No. 4882)

RAI Question No. 12.03-12.04-6

NRC RAI 12.03-12.04-6

Subsection 12.3.1.5.1 of the ESBWR DCD Tier 2, Revision 6, states that the piping for the following SSCs will contain segments that will have to be run underground; 1) Condensate Storage Tank (CST) and CST Retention Area Drain, 2) Radwaste Effluent Discharge Pipeline, 3) Cooling Tower Blowdown Line, and 4) Hot Machine Shop Drain. This section of the DCD goes on to state that these lines will be kept as short and direct as possible. RG 4.21 states that applicants covered by 10 CFR 20.1406 should strive to minimize leaks and spills, provide containment in areas where such leaks might occur, and provide for detection that supports timely assessment and appropriate response. Fermi FSAR Subsection 12.3.1.5 provides supplemental information to address STD COL 12.3-4-A (which states that the COL Applicant will address the operational and post-construction objectives of RG 4.21). However, Fermi FSAR Subsection 12.3.1.5 does not include a description of site-specific provisions to minimize the potential for unmonitored and uncontrolled releases to the environment from underground piping.

In order to address objectives of RG 4.21 with respect to the monitoring of underground piping at Fermi, FSAR Subsection 12.3.1.5 should be modified to:

1. *Include a listing of the SSCs at Fermi which will have piping segments which will be run underground.*

2. *Include a description of the features associated with the underground piping for each of these SSCs to minimize contamination in accordance with the guidance provided in RG 4.21 and the requirements of 10 CFR 20.1406.*

3. *Include a description of the monitoring program associated with the piping for each of these SSCs that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment from these pipes will be minimized.*

4. *Include a description of the portion of the discharge line that runs from the cooling tower blowdown to the point of release into the environment beyond the owner-controlled area or EAB. Include a description of the monitoring program associated with this portion of the discharge piping that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment will be minimized.*

5. *Incorporate by reference NEI Template 08-08A, which addresses the guidance provided in RG 4.21 and the requirements of 10 CFR 20.1406. NEI 08-08A states that the COL applicant will establish an on-site ground water monitoring program to ensure timely detection of inadvertent radiological releases to the ground water. Identify areas of the site to be specifically considered in this groundwater monitoring program.*

Response

1. *Include a listing of the SSCs at Fermi which will have piping segments which will be run underground.*

   The ESBWR DCD, Revision 7, Section 12.3.1.5 identifies the following systems that have segments of underground piping. These systems are identified in DCD Section 12.3.1.5 as they could potentially contain radioactive fluid.

   - Condensate Storage Tank (CST) Piping and CST Retention Area Drain
   - Radwaste Effluent Discharge Pipeline
   - Cooling Tower Blowdown Line
   - Hot Machine Shop Drain

   Other systems at Fermi 3 that have piping segments which will be run underground include the following. These systems do not have the potential to contain radioactive fluid.

   - Circulating Water System
   - Plant Service Water System
   - Makeup Water System
   - Fire Protection System
   - Station Water System
   - Fuel Oil Systems
   - Potable Water and Sanitary Systems
   - Gas Systems (e.g., Hydrogen, Oxygen, and Nitrogen)

2. *Include a description of the features associated with the underground piping for each of these SSCs to minimize contamination in accordance with the guidance provided in RG 4.21 and the requirements of 10 CFR 20.1406.*

   The underground piping at Fermi that could potentially contain radioactive fluids are as follows:

   - Condensate Storage Tank (CST) Piping and CST Retention Area Drain
   - Radwaste Effluent Discharge Pipeline
   - Cooling Tower Blowdown Line
   - Hot Machine Shop Drain

   For these systems, features provided to minimize contamination in accordance with the guidance provided in Regulatory Guide 4.21 and the requirements of 10 CFR 20.1406 are discussed in ESBWR DCD, Revision 7, Section 12.3.1.5.1. FSAR Section 12.3.1.5 incorporates DCD Section 12.3.1.5.1 by reference. There are no other piping segments, beyond those described in DCD Section 12.3.1.5, at Fermi that could potentially contain radioactive fluid. A brief description will be added to the Fermi 3 FSAR to state that there are no piping segments, other than those described in the DCD, that require design features to minimize contamination.

3. *Include a description of the monitoring program associated with the piping for each of these SSCs that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment from these pipes will be minimized.*

   The monitoring program for these systems is described in ESBWR DCD, Revision 7, Section 12.3.1.5.1; which states that these lines are either enclosed within a guard pipe and monitored for leakage, or are accessible for visual inspections via a trench or a tunnel. FSAR Section 12.3.1.5 incorporates DCD Section 12.3.1.5.1 by reference. A brief description will be added to the Fermi 3 FSAR to state that there are no piping segments, other than those described in the DCD, that require monitoring to ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment from these pipes is minimized.

4. *Include a description of the portion of the discharge line that runs from the cooling tower blowdown to the point of release into the environment beyond the owner-controlled area or EAB. Include a description of the monitoring program associated with this portion of the discharge piping that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment will be minimized.*

   As described in FSAR Section 10.4, the blowdown from the Circulating Water System is from the discharge of the Circulating Water pumps and is discharged to the plant outfall. FSAR Figure 2.1-204, "Fermi 3 Site Plan," shows the location of the outfall; labeled as "Circ Water Outfall" on the figure. The blowdown line is a four (4) foot diameter pipe with the outfall located approximately 1300 feet into Lake Erie to avoid recirculation and preclude the discharge from intruding on environmentally sensitive onsite areas (such as wetlands). The blowdown pipe is routed underground before it enters the lake with the discharge located below the water surface. Features provided to minimize contamination and the associated monitoring program are described in ESBWR DCD, Revision 7, Section 12.3.1.5.1; which states that

   > "these lines will be designed to preclude inadvertent or unidentified leakage to the environment. They are either enclosed within a guard pipe and monitored for leakage, or are accessible for visual inspections via a trench or a tunnel. Threaded and flanged connections will be kept to a minimum. Other joints will be welded or otherwise permanently bonded depending on the piping material."

   FSAR Section 12.3.1.5 incorporates DCD Section 12.3.1.5.1 by reference. It is noted that FSAR Revision 2 is based on DCD Revision 6. Subsequent revision to the FSAR will incorporate DCD Revision 7, or later. These features and monitoring program are applicable up to the location where the blowdown pipe enters Lake Erie.

5. *Incorporate by reference NEI Template 08-08A, which addresses the guidance provided in RG 4.21 and the requirements of 10 CFR 20.1406. NEI 08-08A states that the COL*

applicant will establish an on-site ground water monitoring program to ensure timely detection of inadvertent radiological releases to the ground water. Identify areas of the site to be specifically considered in this groundwater monitoring program.

As described in FSAR Section 12.3.1.5.2, Fermi 3 will comply with the requirements of 10 CFR 20.1406, consistent with the guidance in Regulatory Guide 4.21. The description in FSAR Section 12.3.1.5.2 will be updated to also refer to NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination." The on-site groundwater monitoring program is described in FSAR Section 2.4.12.4. As described in FSAR Section 2.4.12.4, monitoring wells will be installed both upgradient and downgradient of Fermi 3. Currently, there are several monitoring wells located on-site. Current flow gradients, based on current configuration of the site, are described in FSAR Section 2.4.12. Following construction of Fermi 3, shallow and bedrock piezometers and monitoring wells will be used to evaluate groundwater flow patterns with Fermi 3 in place. Based on the post construction flow patterns, if the current well locations are not sufficient for monitoring, new wells will be installed. A reference to NEI 08-08A will also be added to FSAR Section 2.4.12.4 to ensure that the considerations in NEI 08-08A are included in the groundwater monitoring program.

Proposed COLA Revision

Proposed Fermi 3 ER and FSAR markups to clarify design considerations and to reflect changes due to incorporation of NEI 08-08A are shown in the attached markups.

Markup of Detroit Edison COLA
(following 8 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA, Part 2, FSAR. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

Table 1.6-201 Referenced Topical Reports [EF3 SUP 1.6-1]

Report No.	Title	Section No.
NEI 06-13A	Nuclear Energy Institute, "Technical Report on Template for an Industry Training Program Description," NEI 06-13A, Revision 1, March 2008	Appendix 13 BB
NEI 06-14A	Nuclear Energy Institute, "Quality Assurance Program Description," NEI 06-14A, Revision 4, July 2007	17.5
NEI 07-02A	Nuclear Energy Institute, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed under 10 CFR Part 52," NEI 07-02A, March 2008	17.6
NEI 07-03	Nuclear Energy Institute, "Generic FSAR Template Guidance for Radiation Protection Program Description," NEI 07-03, Revision 3, October 2007	Appendix 12 BB
NEI 07-08	Nuclear Energy Institute, "Generic FSAR Template Guidance for Ensuring That Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)," NEI 07-08, Revision 0, September 2007	Appendix 12 AA
NEI 07-09A	Nuclear Energy Institute, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," NEI 07-09A, Revision 0, March 2009	11.5
NEI 07-10A	Nuclear Energy Institute, "Generic FSAR Template Guidance for Process Control Program (PCP)," NEI 07-10A, Revision 0, March 2009	11.4
NEI 06-12	Nuclear Energy Institute, "B.5.b. Phase 2 & 3 Submittal Guideline," NEI 06-12, Revision 3, September 2009	13.6
NEI 08-09	Nuclear Energy Institute, "Cyber Security Plan for Nuclear Power Reactors", NEI 08-09, Revision 3, September 2009	13.6
ST-56834/P	General Electric Company, "ESBWR Steam Turbine - Low Pressure Rotor Missile Generation Probability Analysis," ST-56834/P, Revision 1, June 17, 2009	10.2

NEI 08-08A	Nuclear Energy Institute, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," NEI 08-08A, Revision 0, October 2009.	12.3

Table 1.9-202 Conformance with Regulatory Guides (Sheet 22 of 25)

[EF3 COL 1.9-3-A]

RG Number	Title	Revision	Date	RG Position	Evaluation
1.209	Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants	Rev. 0	Mar-07	General	Conforms. Operational program implementation is described in Section 13.4
4.7	General Site Suitability Criteria for Nuclear Power Stations	Rev. 2	Apr-98	General	Conforms.
4.15	Quality Assurance for Radiological Monitoring Programs (Inception Through Normal Operations to License Termination) – Effluent Streams and the Environment	Rev. 2 (Interim)	Mar-07	General	Conforms. Subsection 11.5.4.5 (NEI 07-09A) provides a description of the ODCM. The implementation milestone is provided in Section 13.4
4.21	Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning	Rev 0	Jun-08	General	Conforms through implementation of NEI 08-08.
5.44	Perimeter Intrusion Alarm Systems	Rev. 3	Oct-97	General	Conforms to one test option as discussed in the RG defined by a plant station procedure.
5.62	Reporting of Safeguards Events	Rev. 1	Nov-87	General	Not applicable. Reportability of Safeguards Events is in accordance with 10 CFR 73 Appendix G.
5.66	Access Authorization Program for Nuclear Power Plants	Rev. 0	Jun-91	General	Not applicable. NEI 03-01, Revision 1, April 2004 is used.
5.69	Guidance for the Application of the Radiological Sabotage Design-Basis Threat in the Design, Development, and Implementation of a Physical Security Program that meets 10 CFR 73.55 Requirements	Rev 0	Aug-07	General	Conforms
8.1	Radiation Symbol	Rev. 0	Feb-73	General	Conforms. The facility utilizes standard radiation symbols.

A

near the Fermi plant. Under pre-development conditions, with this gradient and the range of hydraulic conductivities discussed in the previous paragraph, calculated groundwater velocities range from 0.003 to 0.5 m/day (0.01 to 1.76 ft/day). Based on this range of velocities, the estimated groundwater travel time for the (1,476 ft) pathway east to Lake Erie ranges from 2.3 years to 368 years.

2.4.12.4 **Groundwater Monitoring**

A limited groundwater level monitoring program at Fermi 2 is currently performed as part of the Radiological Environmental Monitoring Program (REMP). Fermi 2 has four groundwater wells included in its REMP which are monitored monthly for water levels and sampled quarterly for the radionuclides and sensitivities specified in the Offsite Dose Calculation Manual (ODCM) (Reference 2.4-289).

In addition, 16 groundwater monitoring wells have been installed around Fermi 1 in support of decommissioning activities. These are also sampled on a quarterly basis with samples assayed for tritium and gamma emitters for the sensitivities specified in the Fermi 2 ODCM.

Some of the existing Fermi 3 piezometers will be abandoned prior to construction activities due to anticipated earth work and heavy construction requirements. It is not anticipated that this will affect any future groundwater monitoring program. **[START COM 2.4-12-001]** However, prior to the commencement of construction activities, the monitoring well network will be evaluated to determine if any significant data gaps are created by the abandonment of existing wells.

As part of the detailed design for Fermi 3, the present groundwater monitoring programs will be evaluated with respect to the addition of Fermi 3 to determine if any modification of the existing programs is required to adequately monitor plant effects on the groundwater. **[END COM 2.4-12-001]** As mentioned previously, several wells exist on-site from previous projects and investigations. It may be possible to integrate some of these wells into future monitoring activities. Any revised integrated monitoring plan will adhere to the guidance outlined in "Integrated Ground-Water Monitoring Strategy for NRC-Licensed Facilities and Sites: Logic, Strategic Approach and Discussion" (Reference 2.4-290). Possible components of monitoring plans to be evaluated may include the following for both the overburden and the Bass Islands aquifer.

and NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination."

- Construction Groundwater Monitoring
  - During construction dewatering, piezometers are monitored as needed to evaluate drawdown of overburden and bedrock groundwater levels associated with dewatering. Detroit Edison will use Fermi 3 wells or piezometers, as appropriate. Monitoring is performed at frequent intervals when construction dewatering begins, in order to document water level declines. Monitoring frequency is reduced after dewatering levels have stabilized.
  - Post construction dewatering: Monitor shallow and bedrock piezometers and monitoring wells monthly to establish groundwater flow patterns with Fermi 3 in-place. Use dewatering piezometers and Fermi 3 monitoring wells and piezometers, as appropriate.
- Pre-operational Groundwater Monitoring:
  - Two monitoring well nests, one upgradient and one downgradient of Fermi 3, are established. The monitoring well nest locations are based ~~on the~~ post dewatering flow patterns. If existing wells are insufficient, new wells ~~may~~ be installed.

will

  - One set of groundwater samples is collected from each of the Fermi 3 upgradient and downgradient locations. The water samples are analyzed for radionuclides and sensitivities specified in the ODCM. These results are used to characterize background water quality.
  - Measure groundwater levels monthly. Use dewatering piezometers and Fermi 3 piezometers, as appropriate.
- Operational Groundwater Monitoring:
  - ~~Measure groundwater levels quarterly. Use new upgradient and downgradient monitoring locations, dewatering piezometers, and Fermi 3 hydrogeology monitoring locations, as appropriate.~~
  - ~~Groundwater samples are collected quarterly for radionuclide monitoring (REMP). Samples are collected from upgradient and downgradient wells of Fermi 3, and existing REMP wells included in the current Fermi 2 monitoring program. The water samples are analyzed for radionuclides and sensitivities specified in the ODCM.~~

The on-site groundwater monitoring program will be developed consistent with NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination."

- Operational Groundwater Accident Monitoring.
  - This is triggered in the event of an accidental liquid release from Fermi 3, and includes monthly groundwater sampling of the upgradient well and selected wells located downgradient from the point of release. Wells are selected based on flow directions documented in the most recent water level maps available for the

12.3 Radiation Protection

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

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.

Insert 1 here.

12.3.1.5.2 Operational/Programmatic Considerations

Replace this section with the following.

STD COL 12.3-4-A

~~Operational programs and procedures that address the requirements of 10 CFR 20.1406 are necessary adjuncts to the design features. The operational and post-construction objectives in Regulatory Guide 4.21 Positions C.1 through C.4 are addressed as follows:~~

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

Insert 1

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.

12.3.7 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, Rev. 0.

Table 13.4-201 Operational Programs Required by NRC Regulations (Sheet 8 of 8) [STD COL 13.4-1-A] [STD COL 13.4-2-A]

Item	Program Title	Program Source (Required by)	Section	Implementation Milestone	Implementation Requirement
	Preservice Thermal Movement Inspection	10 CFR 50.55a(g) 10CFR 50.55a(b)(3)(v)	3.9.3.7.1(3)e	During intial heatup and cooldown	10 CFR 50.55a(g) ASME OM Code, ISTD (Reference 13.4-202)
	Preservice Testing Program	10 CFR 50.55a(g) 10CFR 50.55a(b)(3)(v)	3.9.3.7.1(3)e	Prior to fuel load	License condition
Notes: a. Snubber inservice examination is intially performed not less than two months after attaining 5% reactor power operation and will be completed within 12 calendar months after attaining 5% reactor power.					
21.	Mitigative Strategies Description and Plans	10 CFR 50.54(hh)(2) 10CFR 52.80	13.6	Prior to fuel load authorization per 10 CFR 52.103(g)	License Condition **[COM 13.4-033]**
22.	Life Cycle Minimization of Contamination	10 CFR 20.1406	12.3	Prior to fuel load	License Condition [COM 13.4-034]

Markup of Detroit Edison COLA
(following 2 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA, Part 3, ER. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

and NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination" (Reference 2.3-107).

(Reference 2.3-105). Possible components of monitoring plans to be evaluated may include the following for both the overburden and the Bass Islands aquifer.

- Construction Groundwater Monitoring:
  - During construction dewatering, piezometers are monitored as needed to evaluate drawdown of overburden and bedrock groundwater levels associated with dewatering. Detroit Edison will use Fermi 3 wells or piezometers, as appropriate. Monitoring is performed at frequent intervals when construction dewatering begins, in order to document water level declines. Monitoring frequency is reduced after dewatering levels have stabilized.
  - Post construction dewatering: Monitor shallow and bedrock piezometers and monitoring wells monthly to establish groundwater flow patterns with Fermi 3 in-place. Use dewatering piezometers and Fermi 3 monitoring wells and piezometers, as appropriate.
- Pre-operational Groundwater Monitoring:
  - Two monitoring well nests, one upgradient and one downgradient of Fermi 3, are established. The monitoring well nest locations are based on the post dewatering flow patterns. If existing wells are insufficient, new wells ~~may~~ will be installed.
  - One set of groundwater samples is collected from each of the Fermi 3 upgradient and downgradient locations. The water samples are analyzed for radionuclides and sensitivities specified in the ODCM. These results are used to characterize background water quality.
  - Measure groundwater levels monthly. Use dewatering piezometers and Fermi 3 piezometers, as appropriate.
- Operational Groundwater Monitoring:
  - ~~Measure groundwater levels quarterly. Use new upgradient and downgradient monitoring locations, dewatering piezometers, and Fermi 3 hydrogeology monitoring locations, as appropriate.~~
  - ~~Groundwater samples are collected quarterly for radionuclide monitoring (REMP). Samples are collected from upgradient and downgradient wells of Fermi 3, and existing REMP wells included in the current Fermi 2 monitoring program. The water samples are analyzed for radionuclides and sensitivities specified in the ODCM.~~

  The on-site groundwater monitoring program will be developed consistent with NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination" (Reference 2.3-107).
- Operational Groundwater Accident Monitoring:
  - This is triggered in the event of an accidental liquid release from Fermi 3, and includes monthly groundwater sampling of the upgradient well and selected wells located downgradient from the point of release. Wells are selected based on flow directions documented in the most recent water level maps available for the site. The water samples are analyzed for radionuclides and sensitivities specified in the ODCM.

2.3-103 Driscoll, F.G., "Groundwater and Wells," 2nd Edition, Johnson (Well Screen) Division, St. Paul, Minnesota, 1986.

2.3-104 Detroit Edison, "Fermi 2, Offsite Dose Calculation Manual," Revision 14, 1999.

2.3-105 U.S. Nuclear Regulatory Commission, "Integrated Ground-Water Monitoring Strategy for NRC Licensed Facilities and Sites: Logic, Strategic Approach and Discussion," Advanced Environmental Solutions LLC for Division of Fuel, Engineering, and Radiological Research, Office of Nuclear Regulatory Research, NUREG/CR-6948, November 2007.

2.3-106 AECOM, "Water Quality Survey, The Detroit Edison Company, Fermi 3 Project, Final Report," November 2009.

2.3-107 Nuclear Energy Institute, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," NEI 08-08A, Revision 0, October 2009.

Attachment 2
NRC3-10-0046

Response to RAI Letter No. 42
(eRAI Tracking No. 4882)

RAI Question No. 12.03-12.04-8

NRC RAI 12.03-12.04-8

ESBWR DCD Tier 2, Revision 6, Figure 12.3-33 shows the Condensate Storage Tank (CST) being located adjacent to and west of the turbine building. It is not clear from this figure if the CST will be located in an enclosing structure. Provide a description of the CST as it will be located at Fermi. Include in this description:

- *The physical location of the CST.*
- *A description of any enclosure or other barrier surrounding the CST that would restrict personnel access to the CST. Since the CST is connected to and provides storage capacity for several potentially contaminated plant systems, the staff has a concern that the CST may represent a potential source of radiation that is located in an area where personnel access is uncontrolled. Regulatory Guide 1.70 states that sources of radiation should be described in the manner needed as input to the shield design calculation, and that the description should tabulate sources by isotopic composition, strength, and geometry, as well as provide the basis for the values. In addition, COL Information Item 12.2-4-A, "Other Contained Sources", states that "The COL Applicant will address any additional contained radiation sources (including sources for instrumentation and radiography) not identified in Subsection 12.2.1." Therefore, in accordance with the guidelines contained in Regulatory Guide 1.70, and in order to address COL Information Item 12.2-4-A with respect to the CST, the COL applicant should modify the FSAR to provide:*
    - *A listing of the expected radionuclides and associated maximum radionuclide source strengths contained in the CST.*
    - *The dimensions, wall composition, and wall thickness of the CST.*
    - *The calculated maximum expected dose rate at 30 cm from the outside surface of the CST.*
    - *Since the CST appears to be located outdoors, provide a description in the FSAR of:*
    - *the radiation zone classification assigned to the area in the immediate vicinity of the CST*
    - *any physical or administrative features that will be incorporated to limit access to the CST to ensure that radiation doses to personnel who may be in the vicinity of this tank are ALARA and do not exceed the applicable dose limits.*

Response

The location of the Condensate Storage Tank (CST) is shown on FSAR Figure 2.1-204. The CST is item 19, located near the northwest corner of the Turbine Building.

The Condensate Storage Tank (CST) is part of the Condensate Storage and Transfer System (CS&TS) as described in DCD Section 9.2.9, which is incorporated by reference in the Fermi 3 FSAR. The CS&TS provides condensate quality water for normal startup, power operation and normal shutdown. The CST is not part of the Liquid Waste Management System (LWMS) however the CST is addressed in DCD Section 11.2 as an alternative for disposition of treated radioactive water. Since the CST is not part of the LWMS, the details of the system, including items such as function and volume, are described in DCD Section 9.2.6 in lieu of DCD Section 11.2.

In order to maintain the quality of the CST water, the inputs to the CST are limited. The primary source of water to the CST is purified and demineralized water from the Makeup Water System. In addition to water from the Makeup Water System, which does not contain contaminants, there are three potentially contaminated inputs to the CST.

- Recycled water from the Control Rod Drive (CRD) System routed back to the CST. The design of the CRD System ensures that the recycled water is not contaminated by other water systems so that the recycled water is the same quality as the CST water.
- In the event that the water level in the condenser is too high, condensate reject is sent to the CST. The point at which condensate is transferred to the CST is located downstream of the condensate demineralizers. To provide a conservative source term, the radionuclides in the condensate are determined using parameters for the fraction of radionuclides in the steam that are treated by the demineralizers and demineralizer removal efficiencies from DCD, Table 11.1-3.
- In order to minimize liquid releases from the plant, treated water from LWMS may also be recycled to the CST.

The CRD System recycle has the same activity level as the CST, and thus will not affect the radioactivity in the CST. To estimate the maximum activity expected in the CST, contributions from both the condensate reject and the LWMS recycle were considered.

The condensate reject activity is estimated by taking the reactor water source terms in DCD Section 11.1 except for noble gas and N-16, and adjusting them by main steam carryover fractions and condensate demineralizer removal parameters in DCD Table 11.1-3. The reactor water iodine concentrations from DCD Table 11.1-4b are used, which are conservative relative to the site specific reactor water iodine concentrations described in Detroit Edison Letter NRC3-10-0040, dated September 1, 2010.

The transfer of condensate to the CST is only expected to occur if the water level in the condenser is too high, an infrequent occurrence. To be conservative, it is assumed that the concentration in the CST from the condensate reject is the same as the concentration of the condensate system using associated parameters from DCD Table 11.1-3. This approach is conservative as it does not account for decay that would occur as the CST is filled with condensate, producing an overestimation of short lived isotopes. It also does not account for the additional dilution due to makeup from the Makeup Water System.

As shown on DCD Figure 11.2-1 the treated water from the LWMS is stored in the Equipment Drain Sample Tank prior to being recycled to the CST. DCD Table 12.2-13b provides the activity levels in the Equipment Drain Sample Tank. To be conservative, it is assumed that the activity in the CST from the LWMS recycle is the same as the Equipment Drain Sample Tank.

Tritium activity in the CST is assumed to be 370 Bq/gm in accordance with DCD Section 11.1.2. This is conservative as it does not account for dilution due to makeup from the Makeup Water System.

To establish a bounding source term, the activity concentrations for each isotope for the condensate reject and LWMS recycle are compared and the largest value selected as the bounding activity in the CST. The resulting activity concentrations are then multiplied by the volume of the CST (4,885 m^3 per DCD Table 9.2-10) to obtain the total activity in the CST. The resulting activity concentration and inventory for each radionuclide is shown in Table 1.

The DCD does not provide dimensions (height and diameter) for the CST, nor has the design progressed to the point where the CST dimensions have been determined. For the purposes of estimating exposure from the CST, two different cases were assessed based on tank aspect ratio (ratio of tank height to tank diameter). The two aspect ratios considered were 0.5 and 2.0 as these are considered a representative range for tank configuration. At aspect ratios below 0.5 the overall tank footprint becomes very large. At aspect ratios greater than 2.0, the tank is tall and results in large bearing load. Based on discussions with a tank vendor, it is expected that the actual tank confirmation will be closer to the shorter tank configuration. The taller tank configuration is also considered herein to determine if the configuration impacts the estimated exposure rates. The water height in the tank for each tank configuration is determined by dividing the tank area in m^2 into the total CST water capacity of 4885 m^3. The resulting tank dimensions were used:

Tank Configuration	Approximate Diameter (m)	Approximate Height (m)	Water Height (m)
Shorter Tank Aspect Ratio = 0.5	24	12	10.8
Taller Tank Aspect Ratio = 2.0	15	30	27.6

The DCD does not provide the material or thickness for the CST, nor has the design progressed to the point where the CST dimensions have been determined. For the purposes of estimating the exposure rate from the CST, thinner wall material provides less shielding and is conservative. Thus, to be conservative, a tank wall thickness of 3/16" (0.476 cm) is used based on a minimum tank wall thickness specified by API Standard 620, "Design and Construction of Large, Welded, Low-pressure Storage Tanks." The tank wall material is assumed to be stainless steel to minimize the potential for CST to introduce corrosion products into the condensate system.

Using the inputs for source term and tank configuration, the two tank configurations were modeled using the MicroShield computer code. The results from the analysis estimated a dose rate at 30 centimeters from the CST of 2.2 mrem/hour for the shorter tank and 2.1 mrem/hour for the taller tank. This dose rate is below the threshold to be considered as a radiation area per 10 CFR 20.1003 and no special physical or administrative features are required to limit access to the CST to ensure that radiation doses to personnel who may be in the vicinity of this tank are ALARA and do not exceed the applicable dose limits.

Table 1
Bounding Radionuclide Concentration and Inventory
In the Condensate Storage Tank

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
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

Radionuclide	CST Source Term Concentration	CST Source Term Inventory
	µCi/cc	Curies
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

Proposed COLA Revision

Proposed markups are included for FSAR Chapter 12 that includes pertinent information from the above response.

Markup of Detroit Edison COLA
(following 4 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

STD COL 12.1-1-A This COL item is addressed in Subsection 12.1.1.3.2 and Appendix 12BB.

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 and Appendix 12BB.

12.1-3-A **Operational Considerations**

STD COL 12.1-3-A This COL item is addressed in Subsection 12.1.3 and Appendix 12BB.

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 and Appendix 12BB.

12.2 Plant Sources

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

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.

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.

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.

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 separate 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 . 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. These source terms are provided in DCD Table 12.2-16. Design basis noble gas, iodine, and other fission product concentrations are taken from the tables in DCD Chapter 11. Specific details and information on the derivation of the airborne source terms are provided in DCD Appendix 12B.

Insert 1

Table 12.2-207 Bounding Radionuclide Concentration and Inventory in the Condensate Storage Tank [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
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

Radionuclide	CST Source Term Concentration	CST Source Term Inventory
	µCi/cc	Curies
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

Attachment 3
NRC3-10-0046

Response to RAI Letter No. 42
(eRAI Tracking No. 5016)

RAI Question No. 14.03.03-1

NRC RAI 14.03.03-1

In Fermi 3 COLA, Part 2, item EF3 COL 14.3A-1-1, the applicant identified that piping DAC closure notification will be at least 6 months before scheduled completion of all ASME Code design reports for risk-significant piping packages.

In DCD Section 14.3A.2, GEH states that the piping design may be completed on a system-by-system basis for applicable systems and, in order to support closure of the Design Acceptance Criteria ITAAC, information will be made available for NRC review, inspection, and audit on a system basis.

10 CFR 52.99(a) states that "The licensee shall submit to the NRC, no later than 1 year after issuance of the combined license or at the start of construction as defined in 10 CFR 50.10(a), whichever is later, its schedule for completing the inspections, tests, or analyses in the ITAAC. The licensee shall submit updates to the ITAAC schedules every 6 months thereafter and, within 1 year of its scheduled date for initial loading of fuel, the licensee shall submit updates to the ITAAC schedule every 30 days until the final notification is provided to the NRC under paragraph (c)(1) of this section."

The staff noted that the risk-significant piping packages completion schedule does not support closure of the DAC ITAAC on a system basis and current proposed position does not meet 10 CFR 52.99(a). The staff is requesting the applicant to provide an acceptable alternative or clarify its position to support closure of DAC ITAAC.

Response

Detroit Edison has clarified commitments for implementation schedules and updates to support closure of DAC ITAAC as discussed below.

[START COM FSAR-3.10-003] Detroit Edison shall submit to the NRC, no later than 1 year after issuance of the combined license or at the start of construction as defined in 10 CFR 50.10(a), whichever is later, its implementation schedules for completing of the following ITAACs. Detroit Edison shall submit updates to the ITAAC schedules every 6 months thereafter and, within 1 year of its scheduled date for initial loading of fuel, and shall submit updates to the ITAAC schedules every 30 days until the final notification is provided to the NRC under paragraph (c)(1) of this section. [END COM FSAR-3.10-003]

- [START COM FSAR-14.3-001] For piping DAC; (1) The ASME Code design reports for risk-significant piping packages and (2) The Pipe Break Analysis Report may be completed on a system-by-system basis for applicable systems in order to support closure of the Design Acceptance Criteria ITAAC. Information will be made available for NRC review, inspection, and audit on a system basis. Information will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. [END COM FSAR-14.3-001]

- [START COM FSAR-14.3-002] For human factors engineering DAC, HFE Design Acceptance Criteria ITAAC consists of a series of results summary reports which verify that the specific associated Design Commitment is met. The summary reports will be made available at each stage for NRC review, inspection, and audit on a system basis. Information (procedures and test programs) will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. [END COM FSAR-14.3-002]

- [START COM FSAR-14.3-003] For instrumentation and controls DAC, the set of ESBWR digital I&C Design Acceptance Criteria ITAAC establishes a phased Design Acceptance Criteria ITAAC closure process. Procedures and test programs necessary to demonstrate that the Design Acceptance Criteria ITAAC requirements are met will be used at each phase to certify to the NRC that the design is in compliance with the certified design. Information will be made available for NRC review, inspection, and audit on a system basis. Information will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. [END COM FSAR-14.3-003]

Proposed COLA Revision

The FSAR will be revised as described in the attached markup.

Markup of Detroit Edison COLA
(following 3 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

SRM-SECY-05-0197, the NRC approved generic EP-ITAAC for use in COL and ESP applications. This set of EP-ITAAC was considered in the development of the plant-specific EP-ITAAC, which are tailored to the ESBWR design. The plant-specific EP-ITAAC are included in a separate part of the COLA.

14.3.9 Site-Specific ITAAC

Delete the last sentence of the first paragraph and add the following at the end of this section.

STD COL 14.3-2-A

The selection criteria and methodology provided in this section of the referenced DCD were utilized as the site-specific selection criteria and methodology for ITAAC. These criteria and methodology were applied to those site-specific (SS) systems that were not evaluated in the referenced DCD. The entire set of ITAAC for the facility, including DC-ITAAC, EP-ITAAC, PS-ITAAC, and SS-ITAAC, is included in COLA Part 10.

14.3.10 COL Information

14.3-1-A Emergency Planning ITAAC

STD COL 14.3-1-A This COL item is addressed in Section 14.3.8.

14.3-2-A Site-Specific ITAAC

STD COL 14.3-2-A This COL item is addressed in Section 14.3.9.

Appendix 14.3A Design Acceptance Criteria ITAAC Closure Process

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

14.3A.1 Design Acceptance Criteria ITAAC Closure Options

Replace the last two sentences of the second paragraph with the following

EF3 COL 14.3A-1-1

Add Insert "1" here

~~[START COM 14.3A.1-001] If, at the time of COL issuance, Fermi Unit 3 is the reference ESBWR plant, the standard approach will be used and the following DAC closure notifications will be made:~~

- For piping DAC, the NRC staff will be notified at least 6 months before (1) scheduled completion of all ASME Code design reports for risk-significant piping packages, and (2) scheduled completion of all (i.e., the last) the pipe break hazard analyses.
- For human factors engineering DAC, the NRC will be notified at least 6 months before the scheduled completion of each results summary report.
- For instrumentation and controls DAC, the NRC staff will be notified at least 6 months before the scheduled completion of each baseline review report and software plan designated as DAC. **[END COM 14.3A.1-001]**

Insert 1

[START COM FSAR-3.10-003] Detroit Edison shall submit to the NRC, no later than 1 year after issuance of the combined license or at the start of construction as defined in 10 CFR 50.10(a), whichever is later, its implementation schedules for completing of the following ITAACs. Detroit Edison shall submit updates to the ITAAC schedules every 6 months thereafter and, within 1 year of its scheduled date for initial loading of fuel, and shall submit updates to the ITAAC schedules every 30 days until the final notification is provided to the NRC under paragraph (c)(1) of this section. [END COM FSAR-3.10-003]

- [START COM FSAR-14.3-001] For piping DAC; (1) The ASME Code design reports for risk-significant piping packages and (2) The Pipe Break Analysis Report may be completed on a system-by-system basis for applicable systems in order to support closure of the Design Acceptance Criteria ITAAC. Information will be made available for NRC review, inspection, and audit on a system basis. Information will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. [END COM FSAR-14.3-001]

- [START COM FSAR-14.3-002] For human factors engineering DAC, HFE Design Acceptance Criteria ITAAC consists of a series of results summary reports which verify that the specific associated Design Commitment is met. The summary reports will be made available at each stage for NRC review, inspection, and audit on a system basis. Information (procedures and test programs) will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. [END COM FSAR-14.3-002]

- [START COM FSAR-14.3-003] For instrumentation and controls DAC, the set of ESBWR digital I&C Design Acceptance Criteria ITAAC establishes a phased Design Acceptance Criteria ITAAC closure process. Procedures and test programs necessary to demonstrate that the Design Acceptance Criteria ITAAC requirements are met will be used at each phase to certify to the NRC that the design is in compliance with the certified design. Information will be made available for NRC review, inspection, and audit on a system basis. Information will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. [END COM FSAR-14.3-003]

Attachment 4
NRC3-10-0046

Response to RAI Letter No. 40 and 42
(eRAI Tracking No. 4936 and 5073)

RAI Question No. 02.04.13-11 (RAI Letter No. 40)
RAI Question No. 02.04.13-12 (RAI Letter No. 42)

NRC RAIs

The following RAIs, from NRC RAI Letters 40 and 42, concern Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters. Detroit Edison has elected to address these RAIs with a single response as discussed with NRC staff.

NRC RAI 02.04.13-11

The applicant responded to RAI Letter No. 28 dated May 7, 2010, that included a description of revisions to the RESRAD-OFFSITE computer model setup and the results of subsequent simulations. The applicant provided computer model input files for four contaminant transport scenarios: 1) transport through the rock fill with a receptor at Lake Erie; 2) transport through the rock fill with a receptor at a groundwater well; 3) transport through the Bass Islands aquifer with a receptor at Lake Erie; and 4) transport through the Bass Islands aquifer with a receptor at a groundwater well. Included in the revised RESRAD-OFFSITE analyses was a correction for the volume of initial source liquid released, and a description of a simulated rapid, below-grade tank release to the aquifer through a very high (525,600/yr) user-specified leach rate.

Inspection of the RESRAD-OFFSITE output ("SUMMARY.REP") files for each of the scenarios indicates that the computer code found the user-specified leach rate (525,600/yr) incompatible with the combination of input parameters. Finding the incompatible leach rate, the computer code calculated a consistent and significantly smaller rate value of 1.8/yr. The result is a modeling analysis that is adding contaminants to the aquifer at a much lesser rate than intended. In addition, the selection of the "Do Not Disperse Vertically" user-controlled option results in clean water infiltrating along the contaminant flowpath. Clean infiltration in this case causes the plume to be driven downward and may not be entirely intercepted by the receptor given the "Depth of Aquifer Contributing" input value.

The applicant should revise the analyses performed by configuring RESRAD-OFFSITE input parameters to use the maximum leach rate permitted by the computer code and carefully selecting input values to avoid clean infiltration along contaminant flowpaths.

NRC RAI 02.04.13-12

Because RESRAD-OFFSITE is a model that is primarily used for time-dependent leaching of soil to flush contaminants into the groundwater flow system, the model may not easily be configured to simulate a large volume instantaneous tank release. The current configuration of the applicant's RESRAD-OFFSITE input parameters precludes the simulation an instantaneous tank release into the aquifer at Fermi. The applicant should correctly configure RESRAD-OFFSITE to simulate an instantaneous release or perform an alternative method of assessing the down gradient activity concentrations due to an instantaneous release. The analysis should initially rely on conservative assumptions and input parameters given the ranges of values of site-specific data. Only if needed should the analysis follow a progressively less conservative approach through the incremental incorporation of appropriate site-specific values of groundwater transport parameters.

Response

Detroit Edison has implemented a progressive approach in the development of FSAR Section 2.4.13 to the current state as provided in Detroit Edison letter NRC3-10-0018 dated May 7, 2010 (ML101320136). This approach is summarized as follows:

- The ESBWR DCD, Section 15.3.16, provides an evaluation of the consequences of a failure of a liquid-containing tank in the Radwaste building. As discussed in DCD Section 15.3.16, based on the provisions included in the design, the analyses of the postulated release of the radioactive liquid from tanks in the Radwaste Building is not included. As stated in DCD Section 15.3.16.3:

  > "The liquid pathway is not considered because of the mitigation capabilities of the Radwaste Building to mitigate the liquid release. General Design Criterion (GDC) 60 is met, as the release of radioactive materials in this case is suitably controlled."

  FSAR, Revision 0, Section 2.4.13, credited these same design provisions discussed in the DCD for demonstrating that measures consistent with NRC Branch Technical Position (BTP) 11-6 were incorporated into the design to preclude accidental release of liquid effluents. Based on the design provisions precluding the release from occurring, an analysis of the postulated release was not included in Revision 0 of the FSAR.

- FSAR Revision 1, Section 2.4.13, incorporated a very conservative transport analysis to estimate the radionuclide concentrations at the receptor. The analysis was performed using a relatively simple straight line flow path model. The model determined the transport time from the source to the receptor. The concentration at the receptor was determined based on the initial concentrations, the decay constants for the radionuclides and the transport time. Mechanisms such as dispersivity and retardation were not credited in the analysis. The results from the analysis indicated that concentrations of several radionuclides could exceed the associated limit in 10 CFR Part 20. Similar to FSAR Revision 0, FSAR Revision 1 to Section 2.4.13 concluded that, based on design features provided in the Radwaste Building, a postulated liquid release to the environment at Fermi 3 is mitigated in a manner consistent with regulatory guidance to preclude the possible release from occurring.

- FSAR Revision 2, Section 2.4.13, and, subsequently, Detroit Edison letter NRC3-10-0018 provided the description of a revised transport analysis performed using the RESRAD-OFFSITE computer code. For specific radionuclides, laboratory testing was performed to determine distribution coefficients. The RESRAD-OFFSITE model was run using the measured distribution coefficients coupled with conservative inputs and assumptions. The results from this refined analysis indicate that the limits specified in 10 CFR Part 20 are satisfied for Fermi 3.

As noted in the RAI, the RESRAD computer code does not effectively model the assumed instantaneous release from the Radwaste building to the Bass Islands aquifer. Thus, an alternate approach has been taken to assess the down gradient activity concentrations due to an instantaneous release from the Radwaste building. The analysis initially relies on conservative assumptions and input parameters given the ranges of values of site-specific data. Radionuclide concentrations resulting from the various steps in the analysis are compared against the maximum permissible concentrations, stated as the effluent concentration limits (ECLs) identified in 10 CFR 20, Appendix B, Table 2, Column 2, to determine acceptability. 10 CFR 20, Appendix B, Table 2 imposes additional requirements when the identity and concentration of each radionuclide in a mixture are known. In this case, the ratio present in the mixture and the concentration otherwise established in 10 CFR 20 for the specified radionuclides not in a mixture must be determined. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity rule"). The sum of fractions approach is applied to the radionuclide concentrations for both pathways. Further analysis, using progressively more realistic assumptions and modeling techniques, is conducted when results using overly conservative assumptions and coefficients cause the radionuclide concentrations to exceed either the ECLs or the sum of fractions unity limit.

Similar to the previous analyses, two different flow paths are modeled:

- Towards the offsite well to the West through the Bass Islands bedrock formation.
- Towards Lake Erie to the East through the Bass Islands bedrock formation.

The previous analyses (described in Detroit Edison Letter NRC3-10-0018) modeled flow paths through the rock fill in addition to the Bass Islands formation. The flow paths through the rock fill due to a release from the Radwaste building are not considered credible as the foundation base of the Radwaste building is founded on the Bass Islands formation. Thus, a release from the Radwaste building would be directly into the Bass Islands formation. Furthermore, as described in FSAR Section 2.4.12.2.3.2.4, the vertical component of groundwater flow is predominantly downward from the overburden to the Bass Islands aquifer. Thus, as the flow path through the rock fill is not considered credible, it is no longer modeled.

In addition to the changes in the methodology used in the analysis, the following additional changes to inputs and assumptions have been made.

- The analysis credits dilution of the source inside the Equipment Drain Collection Tank room prior to release to the groundwater. The analysis assumes instantaneous release of 100% of the tank contents to the room and instantaneous release of the diluted source to the groundwater. As described in FSAR Section 2.4.13.2.2, the water table in the vicinity of the Radwaste building is 27 feet above the floor of the building. Using a total tank volume of 140 m^3, this provides a dilution factor of greater than three (3). No credit is taken for the time period that it takes for the groundwater to enter the room and it is conservatively assumed that this entire liquid volume is instantaneously released from the building. In reality there would be no driving head to cause the release from the room to the groundwater.

- The previous analysis used an effective porosity of 1 percent, based on subsurface materials similar to the Bass Islands formation at the Fermi site. Determinations of site specific effective porosity have been made using site specific measured parameters for hydraulic conductivity and Rock Quality Designation (RQD). Hydraulic conductivity values were determined based on Packer Testing (refer to FSAR Section 2.4.12.2.4.2). Using this method and site specific inputs, effective porosity was estimated at several on site locations with results ranging from 0.1% to 0.8%. For the purposes of the radionuclide transport analysis, the described analysis conservatively uses an effective porosity of 0.1%.

The steps used in the updated analysis are summarized below.

1. The initial step in the analysis was performed only crediting radioactive decay during the transport from the Radwaste Building to the receptor. This analysis assumes that all radionuclides migrate at the same rate as groundwater and considered no adsorption, retardation or dispersion, which could otherwise result in changes in plume concentrations over distance. Under these assumptions, the radionuclide concentration along a groundwater pathline can be expressed as a function of the groundwater travel time. The computed concentrations were compared with the 10 CFR 20, Appendix B, Table 2, ECLs. The ratio of the groundwater concentration to the ECL was used as the screening indicator. Ratios that were greater than or equal to 0.01, which means that the groundwater concentration is predicted to be greater than or equal to one percent of the ECL, were selected for further evaluation using adsorption.

2. The next step was to consider both radioactive decay and adsorption. Distribution (adsorption) coefficients (K_d values) used in the analysis are the same as those previously described in FSAR Section 2.4.13. In this case, the minimum distribution coefficient values were used for each element analyzed irrespective of their sample location. Distribution coefficients for other elements in the analysis were assigned a value of zero, which is conservative since it assumes no retardation during transport. Using the minimum distribution coefficient values ensures that the transport analysis results are conservative. The computed concentrations were compared with the 10 CFR 20, Appendix B, Table 2, ECLs. The ratio of the groundwater concentration to the ECL was used as the screening indicator. Ratios that were greater than or equal to 0.01, which means that the groundwater concentration is predicted to be greater than or equal to one percent of the ECL, were selected for further evaluation using advection and dispersion.

3. For the case of transport to Lake Erie, the radioactivity that enters the lake will be diluted before it reaches the nearest potable water intake. The nearest potable water intake in Lake Erie is approximately 1,600 meters from the point where contaminated groundwater is expected to enter the lake. The lake depth varies, near the vicinity of the shoreline a representative water depth of two meters is used. The nearest potable water intake is the

Wilfred L. LePage Pumping Station 30" intake which is 474 meters offshore. These parameters give a lake volume between where the groundwater enters the lake and nearest potable water intake of more than 1,600,000 m^3. This volume would provide a dilution factor of approximately 3,500. To be conservative, a dilution factor of 10 is applied in the analysis for the nearest potable water intake in Lake Erie. The results for Lake Erie applying the conservative dilution factor indicate that no radionuclides require further evaluation. That is, the predicted concentration of each of the radionuclides at the receptor is less than the associated maximum permissible concentration and the sum of fractions of all of the radionuclides is less than 1.

4. The next step for assessing transport to the off-site well to the west of the site is to consider one-dimensional (longitudinal) dispersion. The representative average linear velocity is considered to best represent subsurface site conditions in the one-dimensional sense along a groundwater pathline for each aquifer. The radionuclides of concern identified by the prior analyses are further evaluated, considering radioactive decay, adsorption, retardation, advection and dispersion using the pathway specific travel times. The predicted concentrations of the radionuclides from the analysis of the closest offsite well pathway using site-specific input conditions and one-dimensional dispersion are all less than their respective ECL; however, the sum of the fractions of all radionuclides slightly exceeds unity at three years. Note that dispersion is only considered for H-3, Ni-63 and Pu-239, while decay and adsorption (where applicable) are considered for the other radionuclides.

5. The next step for assessing transport to the off-site well to the west of the site is to consider two-dimensional (longitudinal and transverse horizontal) dispersion. Considering two-dimensional dispersion, the predicted concentrations of the radionuclides are less than their respective ECLs and the sum of the fractions of all radionuclides is less than unity at all time points.

In conclusion, the analysis to assess downgradient activities from a tank failure in the Radwaste Building has been updated using an alternate methodology to simulate instantaneous release. Further analysis, using progressively more realistic and less conservative assumptions and modeling techniques, were conducted when results using conservative assumptions and coefficients cause the radionuclide concentrations to exceed either the ECLs or the sum of fractions unity limit. The final results satisfied the limits in 10 CFR 20, Appendix B, Table 2.

Proposed COLA Revision

A proposed markup for FSAR Section 2.4.13 to incorporate the above analysis is attached. Also included are proposed markups for FSAR Section 2.4.12.3.2 and ER Section 2.3.1.2.3.2 to reflect the site specific estimates for effective porosity.

Markup of Detroit Edison COLA
(following 45 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA Part 2 FSAR. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

As discussed in Subsection 2.4.12.2.5, the possibility exists for a return to flow toward Lake Erie in the Bass Islands aquifer should all quarry dewatering in the county come to a halt. In this case, the most direct pathway is toLake Erie, approximately 450 m (1476 ft) to the east. This assumes that Lake Erie and the Bass Islands aquifer are in hydraulic communication at the shoreline, which is a conservative assumption.

2.4.12.3.2 Groundwater Travel Times to Discharge Locations

The travel time of groundwater from the center of the Reactor Building to the potential discharge location is dependent of the flow path length and the groundwater flow velocity. The groundwater flow velocity (or seepage velocity) is calculated from the following equation (Reference 2.4-287):

$$V = Ki/ n_e \quad \text{[Eq. 8]}$$

where:

V = Average linear velocity (ft/day)
K = Hydraulic Conductivity (ft/day)
i = Hydraulic gradient (ft/ft)
n_e = Effective porosity (dimensionless)

The travel time to a discharge location is calculated by:

$$T = D/V \quad \text{[Eq. 9]}$$

where:

T = Travel time (days)
D = Distance from center of Reactor Building to discharge location (ft).
V = Average linear groundwater velocity (ft/day)

- Groundwater velocity is locally dependent on hydraulic conductivity, hydraulic gradient, and porosity. Hydraulic conductivity is estimated from slug test and packer test data collected during the Fermi 3 subsurface investigation, and is discussed in Subsection 2.4.12.2.4.1 and Subsection 2.4.12.2.4.2. Hydraulic gradient is estimated from Fermi 3 potentiometric surface maps (November water level maps were selected as being representative of site conditions).

~~No porosity field data was collected, so literature values were used. For the rock fill, only total porosity values were identified in literature; therefore, the total porosity was used to estimate the groundwater flow velocity in the rock fill.~~ Total porosity for the rock fill was estimated to be 25 percent, which is typical of coarse gravel (Reference 2.4-287 and

In addition, for the Bass Islands formation, as described in FSAR Section 2.4.13.2.2, site specific estimates for effective porosity were developed based on site measured parameters for hydraulic conductivity and Rock Quality Designation (RQD). The estimates for effective porosity range from 0.1% to 0.8%. For the purposes of this evaluation, a conservative value for effective porosity of 0.1% is used. These site specific estimates for effective porosity are conservative (less than) relative to the literature values for similar materials.

Reference 2.4-288). For the Bass Islands dolomite, ~~effective and~~ total porosity estimates were located in literature. In Otsego County, Michigan, the total porosity of the Bass Islands is estimated to range from 13 to 21 percent (Reference 2.4-295). In the Milwaukee, Wisconsin area, the effective porosity of dolomite overlain by glacial till was estimated to be 1 percent (Reference 2.4-291).

For flow in the rock fill overburden at Fermi 3, the following conditions are assumed:

- Hydraulic conductivity is 357 m/day (1,170 ft/day) based on the P-385S slug test.
- The gradient is 0.0007, based on the November water table map (Appendix 2.4BB).
- Porosity is 25 percent of the rock fill.

This results in a calculated flow velocity of 0.996 m/day (3.27 ft/day). Appling this velocity to the pathway distance of 250 m (820ft) to the overflow canal, the groundwater travel time is calculated to be 0.69 years (250 days).

For flow in the Bass Islands aquifer under present day potentiometric surface conditions, the following conditions are assumed:

- The average gradient along the flowpath from Fermi 3 to the point that it leaves the site to the west is 0.002.
- Effective porosity is assumed to be ~~1 percent.~~ 0.1 percent

The highest hydraulic conductivity estimate for a packer test that did not indicate vertical leakage to adjacent zones was 5.4 m/day (17.57 ft/day) (MW-395D at 11 m (37 ft): it should be noted that this boring is near the cooling towers, not along the flowpath). The lowest hydraulic conductivity for a valid packer test is 0.034 m/day (0.11 ft/day) (MW-383D at 20 m [67 ft]). Based on the maximum hydraulic conductivity estimate, the calculated velocity is ~~1.1 m/day (3.5 ft/day).~~ 11 m/day (35 ft/day) Based on the minimum hydraulic conductivity estimate, the calculated velocity is ~~0.006 m/day (0.02 ft/day)~~ 0.06 m/day (0.2 ft/day). Based on a pathway distance of 1,450 m (4,756 ft), the two velocity estimates yield groundwater travel time estimates along this pathway to the offsite well west of the site ranging from ~~3.7 years to 652~~ 0.37 years to 65 years years.

To evaluate the pre-development groundwater flow gradient, Figure 2.4-239 was reviewed and an eastward gradient of 0.001 was estimated

0.03 to 5 m/day (0.1 to 17.6 ft/day)

near the Fermi plant. Under pre-development conditions, with this gradient and the range of hydraulic conductivities discussed in the previous paragraph, calculated groundwater velocities range from ~~0.003 to 0.5 m/day (0.01 to 1.76 ft/day)~~. Based on this range of velocities, the estimated groundwater travel time for the (1,476 ft) pathway east to Lake Erie ranges from ~~2.3 years to 368 years~~.

0.23 to 40 years.

2.4.12.4 Groundwater Monitoring

A limited groundwater level monitoring program at Fermi 2 is currently performed as part of the Radiological Environmental Monitoring Program (REMP). Fermi 2 has four groundwater wells included in its REMP which are monitored monthly for water levels and sampled quarterly for the radionuclides and sensitivities specified in the Offsite Dose Calculation Manual (ODCM) (Reference 2.4-289).

In addition, 16 groundwater monitoring wells have been installed around Fermi 1 in support of decommissioning activities. These are also sampled on a quarterly basis with samples assayed for tritium and gamma emitters for the sensitivities specified in the Fermi 2 ODCM.

Some of the existing Fermi 3 piezometers will be abandoned prior to construction activities due to anticipated earth work and heavy construction requirements. It is not anticipated that this will affect any future groundwater monitoring program. **[START COM 2.4-12-001]** However, prior to the commencement of construction activities, the monitoring well network will be evaluated to determine if any significant data gaps are created by the abandonment of existing wells.

As part of the detailed design for Fermi 3, the present groundwater monitoring programs will be evaluated with respect to the addition of Fermi 3 to determine if any modification of the existing programs is required to adequately monitor plant effects on the groundwater. **[END COM 2.4-12-001]** As mentioned previously, several wells exist on-site from previous projects and investigations. It may be possible to integrate some of these wells into future monitoring activities. Any revised integrated monitoring plan will adhere to the guidance outlined in "Integrated Ground-Water Monitoring Strategy for NRC-Licensed Facilities and Sites: Logic, Strategic Approach and Discussion" (Reference 2.4-290). Possible components of monitoring plans to be evaluated may include the following for both the overburden and the Bass Islands aquifer.

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2.4.13 Accidental Releases of Liquid Effluents to Ground and Surface Waters

2.4.13.1 Mitigating Design Features

Mitigating design features specified in NUREG 0800 Branch Technical Position (BTP) 11-6 are incorporated into the design of Fermi 3 to preclude an accidental release of liquid effluents. Descriptions of these features are provided below.

Below-grade tanks containing radioactivity are located on levels B1F and B2F of the Radwaste Building. The Radwaste Building is designed to seismic requirements as specified in DCD Table 3.2-1. In addition, as described in DCD Section 11.2.2.3, compartments containing high level liquid radwaste are steel lined up to a height capable of containing the release of all liquid radwaste in the compartment. Leaks as a result of major cracks in tanks result in confinement of the liquid radwaste in the compartment and the building sump system for containment in other tanks or emergency tanks. Because of these design capabilities, it is not considered feasible that any major event involving the release of liquid radwaste into these vo... of these liquids to the groundwater environm...

Replace Section 2.4.13 (Pages 2-513 through 2-520) in it's entirety with the attached write-up.

The Condensate Stor... Condensate Storage and Transfer Systen... bove-grade tank that potentially could conta... ntainment, the reactor building, or the radw... S, described in DCD Section 9.2.6, meets GDC 60 by compliance with RG 1.143, Position C.1.2 for design features provided to control the release of liquid effluents containing radioactive material. The basin surrounding the tank is designed to prevent uncontrolled runoff in the event of a tank failure. The basin volume is sized to contain the total tank capacity. Tank overflow is also collected in this basin. A sump located inside the retention basin has provisions for sampling collected liquids prior to routing them to the Liquid Waste Management System (LWMS) or the storm sewer as per sampling and release requirements. These design features are intended to preclude the release of liquids from the CST to either the ground or surface water environment via the liquid pathway.

The mitigating design features described above demonstrate that the radioactive waste management systems, structures, and components for

EF3 COL 2.0-24-A

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The Condensate Storage Tank (CST), part of the Condensate Storage and Transfer System (CS&TS), is the only above-grade tank that potentially could contain radioactivity outside of containment, the reactor building, or the radwaste building. The CS&TS, described in DCD Section 9.2.6, meets GDC 60 by compliance with RG 1.143, Position C.1.2 for design features provided to control the release of liquid effluents containing radioactive material. The basin surrounding the tank is designed to prevent uncontrolled runoff in the event of a tank failure. The basin volume is sized to contain the total tank capacity. Tank overflow is also collected in this basin. A sump located inside the retention basin has provisions for sampling collected liquids prior to routing them to the Liquid Waste Management System (LWMS) or the storm sewer as per sampling and release requirements. These design features are intended to preclude the release of liquids from the CST to either the ground or surface water environment via the liquid pathway.

The mitigating design features described above demonstrate that the radioactive waste management systems, structures, and components for Fermi 3, as defined in RG 1.143, include features to preclude accidental releases of radionuclides into potential liquid pathways. Nevertheless, an analysis of accidental releases of radioactive liquid effluents in groundwater is performed. Descriptions and results of these analyses are provided below.

2.4.13.2 Groundwater Analysis

The discussion in Section 2.4.13.1 demonstrates that the Fermi 3 LWMS design will preclude accidental release of radioactive liquid effluents to the environment. Nevertheless, in accordance with SRP 11.2, analyses of the bounding release of radioactive liquid effluents to the groundwater and consequently to the nearest sources of potable water in an unrestricted area are performed.

This section provides a conservative analysis of a postulated, accidental release of radioactive liquid effluents to the groundwater. The accident scenario is described, and the model used to evaluate radionuclide transport is presented, along with potential pathways of contamination to water users. The radionuclide transport analysis is described, and the results are summarized. The radionuclide concentrations are compared against the regulatory limits.

2.4.13.2.1 Accident Scenario

A liquid radwaste tank outside of containment is postulated to fail, coincident with the non-mechanistic failure of the above described mitigating design features, thus allowing the tank contents to be released to groundwater. The volume of the liquid assumed released and the associated radionuclide concentrations were selected to produce an accident scenario that leads to the most adverse contamination of groundwater.

Radwaste tanks outside of containment are located on levels B1F and B2F of the radwaste building as shown on Figure 1.2-25R. The radwaste tanks having the largest volumes include the three equipment drain collection tanks and the two equipment drain sample tanks, all in the lowest level, B2F. Each of these tanks has a volume of approximately 37,000 gallons (140 m^3) per DCD Table 11.2-2a.

Activity concentrations in various liquid radwaste tanks are provided in DCD Tables 12.2-13a through 12.2-13g. Of these tanks, the limiting tank in terms of radionuclide activity is the equipment drain collection tank; whose activity is provided in DCD Table 12.2-13a (DCD Table 2.0-2 for Subsection 2.4.13

identifies DCD Table 12.2-13a as the source term for this analysis).

The scenario assumes that one of the equipment drain collection tanks fails and its contents are released to the groundwater. Note that this accident scenario is extremely conservative because the radwaste building is seismically designed in accordance with RG 1.143, Class RW-IIa, as described in DCD Section 12.2.1.4. Also, each tank cubicle is provided with a steel liner, as described in DCD Section 11.2.2.3, to preclude any potential liquid releases to the environment.

2.4.13.2.2 Transport Model

Based on the COL stage investigations of the Fermi 3 power block and surrounding area documented in Section 2.4.12, specific site characteristics related to groundwater and transport pathway through the underlying material were developed.

The conceptual transport model is used to evaluate the accidental release of radioactive liquid effluent to groundwater. Key elements and assumptions embodied in this evaluation are described and discussed below.

As indicated earlier, one of the equipment drain collection tanks is assumed to be the source of the release, with each tank having a capacity of 140 m^3 (37,000 gal) and radionuclide concentrations as given in DCD Table 12.2-13a. These tanks are located on the lowest level of the radwaste building (level B2F), which has a floor elevation of approximately 540 feet NAVD88 (Figure 2.5.4-204). One of the tanks is postulated to rupture and the contents released to the room.

The assumption of release to the groundwater following tank rupture is conservative because it requires failure of the floor drain system, plus it ignores the barriers presented by the basemat concrete and the steel liners incorporated into the tank cubicles of the radwaste building, which is seismically designed. It should also be recognized that level B2F of the radwaste building is well below the water table. Piezometric head contour maps presented in Figure 2.4-246 through Figure 2.4-249 indicate that the ambient water table in the vicinity of the radwaste building is about 567 feet NAVD88, or 27 ft above the radwaste building floor elevation. If the basemat or exterior walls of the radwaste building and associated steel liners were to fail simultaneously, groundwater would flow into the radwaste building, precluding the release of liquid effluents out of the building. Only if the interior of the radwaste building was flooded to a level higher than the surrounding groundwater would there be a pathway for liquid effluents to be released out of the building and to the groundwater. As described later, this water head is credited for dilution in the equipment drain collection tank room prior to release; however, this head is not credited with precluding or delaying the release. Hence, the assumption of an accidental release of liquid effluents from the radwaste building to groundwater is extremely conservative, given the design features of the radwaste building intended to prevent an accidental release and the hydrogeologic conditions at the site.

In the worst-case postulated accidental release scenario, radionuclides are released directly to the Bass Islands aquifer and migrate with the groundwater in the direction of decreasing hydraulic head. Section 2.4.12.3.1 describes potential pathways in the bedrock (Bass Islands aquifer). As described in Section 2.4.12.3.1 there are two potential pathways for groundwater:

- The documented present day condition, in which the groundwater flow direction in the Bass Islands aquifer is westward off-site.
- A possible future condition in which the flow direction has returned to the east toward Lake Erie.

The present day condition is attributed to dewatering associated with quarrying operations westward of the site. The possible future condition is intended to account for the case where the quarrying operations were to cease. For the purposes of this evaluation, both potential flow paths are considered. To the west off-site, the assumed receptor is a well located at the west corner of Enrico Fermi Drive and Toll Road as shown on Figure 2.4-236. To the east, the receptor is the closest potable water intake in Lake Erie. The distances from the source to each receptor are conservatively selected. For the path from the radwaste building to the well off-site to the west, the source location is assumed to be the closest western side of the radwaste building. For the path from the radwaste building to the potable water intake in Lake Erie, the source is assumed to be the closest eastern side of the radwaste building. Figure 2.4-266 provides a schematic of the conceptual model used for this analysis.

The analysis allows for radionuclide decay during transport by groundwater, and considers this decay in the analysis. Radionuclide transport by groundwater is affected by adsorption by the surrounding soils.

Parameters such as hydraulic conductivity, effective porosity, and hydraulic gradient used in the analysis are provided in Table 2.4-234. All radioisotope constituents of the source term in DCD Table 12.2-13a are included in the analysis.

Effective porosity was estimated using References 2.4-315 and 2.4-316, using site measured parameters for hydraulic conductivity and Rock Quality Designation (RQD) for the corresponding location. Hydraulic conductivity was determined based on Packer Testing (Section 2.4.12.2.4.2). Using this method and site specific inputs, effective porosity was estimated at several on site locations with results ranging from 0.1% to 0.8%. For the purposes of the radionuclide transport analysis, a conservative value for effective porosity of 0.1% is used.

Dilution of the radionuclide source term released from the equipment drain collection tank inside the radwaste building is credited in the analysis. As described above, the ambient water table in the vicinity of the radwaste building is approximately 27 feet above the radwaste building floor elevation. If the basemat or exterior walls of the radwaste building and associated steel liners were to fail simultaneously, groundwater would flow into the radwaste building. Based on the available volume in an equipment drain collection tank room and the entire volume of the tank (140 m^3), the dilution factor would be more than three. For the analysis, a dilution factor of three is credited. The entire diluted volume is then assumed to be released instantaneously outside the radwaste building and available for transport.

Aquifer parameters were established for the Bass Island aquifer (see Section 2.4.12). For this accidental release groundwater transport model, the hydraulic conductivity and hydraulic gradient measured at the site were selected to ensure conservative results.

2.4.13.2.3 **Radionuclide Transport Analysis**

The radionuclide transport analysis is conducted to estimate the radionuclide concentrations in drinking water based on an instantaneous release of the equipment drain collection tank to the equipment drain collection tank room and an instantaneous release of the equipment drain collection tank room contents (diluted as described above) to the Bass Islands aquifer. Release pathways to the nearest offsite well and to the nearest potable water source in Lake Erie are considered.

Analysis of liquid effluent release begins with the simplest of screening models, using demonstratively conservative assumptions and coefficients. Radionuclide concentrations resulting from the screening analysis are then compared against the maximum permissible concentrations, stated as the effluent concentration limits (ECLs) identified in 10 CFR 20, Appendix B, Table 2, Column 2, to determine acceptability. 10 CFR 20, Appendix B, Table 2 imposes additional requirements when the identity and concentration of each radionuclide in a mixture are known. In this case, the ratio present in the mixture and the concentration otherwise established in 10 CFR 20 for the specified radionuclides not in a mixture must be determined. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity"). The sum of fractions approach is applied to the radionuclide concentrations for both pathways. Further analysis, using progressively more realistic and less conservative assumptions and modeling techniques, is conducted when results using conservative assumptions and coefficients cause the radionuclide concentrations to exceed either more than one percent of the associated ECL (i.e.,, the one percent is used as a screening value) or the sum of fractions unity limit. The analysis results are considered to be acceptable when the radionuclide concentrations are all less than the associated ECL and the sum of fractions is less than unity.

This analysis accounts for the parent radionuclides expected to be present in the equipment drain collection tank plus progeny radionuclides that would be generated subsequently during transport. The analysis considered progeny radionuclides in the decay chain sequences. Reference 2.4-317 was used to identify the half lives and decay chain sequences. The derivation of the equations governing the transport of the parent and progeny radionuclides follows.

One-dimensional transport of the parent radionuclide along a groundwater pathline is governed by the advection-dispersion-reaction equation (Reference 2.4-318), which is given as

$$R\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2} - v\frac{\partial C}{\partial x} - \lambda RC \qquad (1)$$

where: C = radionuclide concentration; R = retardation factor; D = coefficient of longitudinal hydrodynamic dispersion; v = average linear velocity; t = groundwater travel time, x = travel distance, and λ = radioactive decay constant. The retardation factor is defined from the relationship

$$R = 1 + \frac{\rho_b K_d}{n_e} \quad (2)$$

where: ρ_b = bulk density; K_d = distribution coefficient; and n_e = effective porosity. The average linear velocity is determined using Darcy's law, which is

$$v = -\frac{K}{n_e}\frac{dh}{dx} \quad (3)$$

where: K = hydraulic conductivity; and dh/dx = hydraulic gradient. The radioactive decay constant can be written as

$$\lambda = \frac{\ln 2}{t_{1/2}} \quad (4)$$

where $t_{1/2}$ = radionuclide half-life.

Using the method of characteristics approach described in Reference 2.4-319, the material derivative of concentration can be written as

$$\frac{dC}{dt} = \frac{\partial C}{\partial t} + \frac{dx}{dt}\frac{\partial C}{\partial x} \quad (5)$$

According to Reference 2.4-318 the coefficient of longitudinal hydrodynamic dispersion (D) is determined from the relationship:

$$D = \alpha_l v \quad (6)$$

The longitudinal dispersivity (α_l) is estimated from Reference 2.4-293, which is based on Reference 2.4-294:

$$\alpha_l = 0.2(x)^{0.56632} \quad (7)$$

where:

α_l = longitudinal dispersivity in meters

x = the distance downgradient from the contaminant source in meters.

From the same references, the average transverse horizontal dispersivity is estimated as

$$\alpha_{th} = 0.28\alpha_l \qquad (8)$$

where:
α_{th} = average transverse horizontal dispersivity in meters

Using site-specific values for x and v, the longitudinal dispersivity and the longitudinal coefficient of hydrodynamic dispersion are obtained. The average transverse horizontal dispersivity is obtained from Equation (8).

To estimate the radionuclide concentrations in groundwater, the following sections describe the equations that are applied as appropriate along the groundwater transport pathways originating at the radwaste building.

2.4.13.2.3.1 **Transport Considering Radioactive Decay**

The initial screening analysis was performed considering radioactive decay only. The Lake Erie pathway is the shortest pathway with the shortest travel time, thus having the least radioactive decay. The offsite well pathway and travel time are longer, allowing more decay time.

This analysis assumed that all radionuclides migrate at the same rate as groundwater and considered no adsorption, retardation or dispersion, which could otherwise result in changes in plume concentrations over distance. Under these assumptions, the radionuclide concentration along a groundwater pathline can be expressed as a function of the groundwater travel time using the Bateman equations as given in Appendix B of Reference 2.4-320. The expressions for the parent, first progeny, and second progeny are as follows:

$$C_1(t) = C_{10}\exp(-\lambda t) \qquad (9)$$

$$C_2(t) = \left(\frac{d_{12}\lambda_2 C_{10}}{\lambda_2 - \lambda_1}\right)\exp(-\lambda_1 t) + \left(C_{20} - \frac{d_{12}\lambda_2 C_{10}}{\lambda_2 - \lambda_1}\right)\exp(-\lambda_2 t) \qquad (10)$$

$$C_3(t) = \left[\frac{d_{13}\lambda_3 C_{10}}{\lambda_3 - \lambda_1} + \frac{d_{23}\lambda_2 d_{12}\lambda_3 C_{10}}{(\lambda_3 - \lambda_1)(\lambda_2 - \lambda_1)}\right]\exp(-\lambda_1 t)$$
$$+\left[\frac{d_{23}\lambda_3 C_{20}}{\lambda_3 - \lambda_2} - \frac{d_{23}\lambda_2 d_{12}\lambda_3 C_{10}}{(\lambda_3 - \lambda_2)(\lambda_2 - \lambda_1)}\right]\exp(-\lambda_2 t) \qquad (11)$$
$$+\left[C_{30} - \frac{d_{13}\lambda_3 C_{10}}{\lambda_3 - \lambda_1} - \frac{d_{23}\lambda_3 C_{20}}{\lambda_3 - \lambda_2} + \frac{d_{23}\lambda_2 d_{12}\lambda_3 C_{10}}{(\lambda_3 - \lambda_1)(\lambda_3 - \lambda_2)}\right]\exp(-\lambda_3 t)$$

where:

C_1 = concentration of the parent radionuclide

C_2 = concentration of the first progeny radionuclide

C_3 = concentration of the second progeny radionuclide

C_{10} = initial concentration of the parent radionuclide

C_{20} = initial concentration of the first progeny radionuclide

C_{30} = initial concentration of the second progeny radionuclide

λ_1 = radioactive decay constant for the parent radionuclide

λ_2 = radioactive decay constant for the first progeny radionuclide

λ_3 = radioactive decay constant for the second progeny radionuclide

d_{12} = fraction of parent radionuclide transitions resulting in first progeny production

d_{13} = fraction of parent radionuclide transitions resulting in second progeny

d_{23} = fraction of first progeny transitions that result in production of second progeny

t = groundwater travel time

The radioactive decay constant expressed in Equation (4) is related to the radionuclide half-life.

The two pathways are screened only crediting radioactive decay using the relevant physical inputs. The results of the screening analysis for each path are presented in Tables 2.4-235 and 2.4-236.

The computed concentrations were compared with the 10 CFR 20, Appendix B, Table 2, ECLs. The ratio of the groundwater concentration to the ECL was used as the screening indicator. Ratios that were greater than or equal to 0.01, which means that the groundwater concentration is predicted to be greater than or equal to one percent of the ECL, were selected for further evaluation using adsorption, advection, and dispersion. The results for Lake Erie where the ratio exceeds 0.01 are highlighted in Table 2.4-235. The results for the nearest offsite well where the ratio exceeds 0.01 are highlighted in Table 2.4-236.

2.4.13.2.3.2 Transport Considering Radioactive Decay and Adsorption

Radionuclides retained from the radioactive decay screening analysis were further evaluated and screened considering adsorption and retardation in addition to radioactive decay.

Distribution (adsorption) coefficients (Kd values) were determined based on laboratory testing of rock samples from the Bass Islands formation. Samples for the laboratory testing were taken from nine different locations on site. The locations for the laboratory testing samples were selected based on the postulated groundwater flow path either to the west to the off site water well or to the east to Lake Erie. Water samples from on-site monitoring wells screened in the Bass Islands aquifer approximately along the flow paths were used during the laboratory testing. Based on the use of site water samples for the laboratory testing, impacts due to potential contaminants in the groundwater at the site that could affect the transport and adsorption are accounted for. In order to simulate the fractured nature of the Bass Islands formation, the samples were broken into pieces for the laboratory testing. The material was not crushed or pulverized as this may not conservatively represent the sub-surface conditions.

Distribution coefficient measurements were obtained for cerium, cesium, cobalt, iron, manganese, ruthenium, silver, strontium, yttrium, and zinc. Selection of radionuclides for determination of distribution coefficients was based on the activity of the equipment drain collection tank source term and screening evaluations. The screening evaluations determined concentrations for the various radionuclides present in the equipment drain collection tank, including the associated progeny(s) considering only the decay of the radionuclides during the transport to the nearest off site water well and surface water body. The results from the screening evaluation were then compared to the 10 CFR Part 20, Appendix B, Table 2, limits. Radionuclides were selected for the laboratory analysis where the concentration predicted, crediting decay only, exceeded the limit.

In the transport analysis, the minimum distribution coefficient values were used for each element analyzed irrespective of their sample location. Distribution coefficients for other elements in the analysis were assigned a value of zero, which is conservative since it assumes no retardation during transport. Using the minimum distribution coefficient values ensures that the transport analysis results are conservative. The values for the distribution coefficients used in the analysis are shown in Table 2.4-234.

Conservatively neglecting hydrodynamic dispersion and using the material derivative of concentration from Equation (5), the characteristic equations for Equation (1) can be expressed as follows:

$$\frac{\partial C}{\partial t} = -\lambda C \tag{12}$$

$$\frac{\partial x}{\partial t} = \frac{v}{R} \tag{13}$$

The solutions of the system of equations comprising Equation (12) and Equation (13) can be obtained by integration to yield the characteristic curves of Equation (1). For the parent radionuclide, the equations representing the characteristic curves can be obtained as:

$$C_1(t) = C_{10} \exp(-\lambda_1 t) \tag{14}$$

where: $t = R_1 L/v$; C_1 = concentration of the parent radionuclide; C_{10} = initial concentration of the parent radionuclide; λ_1 = radioactive decay constant for the parent radionuclide; R_1 = retardation factor for the parent radionuclide; and L = groundwater pathline length.

Similar relationships exist for progeny radionuclides. For the first progeny in the decay chain, the advection-dispersion-reaction equation is:

$$R_2 \frac{\partial C_2}{\partial t} = D \frac{\partial^2 C_2}{\partial x^2} - v \frac{\partial C_2}{\partial x} + d_{12}\lambda_1 R_1 C_1 - \lambda_2 R_2 C_2 \tag{15}$$

where: subscript 2 denotes the first progeny radionuclide; and d_{12} = fraction of parent radionuclide transitions that result in production of the progeny radionuclide. The characteristic equations for Equation (15), again conservatively neglecting hydrodynamic dispersion can be derived as:

$$\frac{\partial C_2}{\partial t} = d_{12}\lambda_1' C_1 - \lambda_2 C_2 \tag{16}$$

$$\frac{\partial x}{\partial t} = \frac{v}{R_2} \tag{17}$$

where: $\lambda_1^{'} = \lambda_1 R_1/R_2$. These equations can be integrated to yield:

$$C_2(t) = K_1 \exp(-\lambda_1^{'} t) + K_2 \exp(-\lambda_2 t) \tag{18}$$

where: $t = R_2L/v$ and for which

$$K_1 = \frac{d_{12}\lambda_2 C_{10}}{\lambda_2 - \lambda_1^{'}}$$

$$K_2 = C_{20} - \frac{d_{12}\lambda_2 C_{10}}{\lambda_2 - \lambda_1^{'}}$$

The advection-dispersion-reaction equation for the second progeny in the decay chain is:

$$R_3\frac{\partial C_3}{\partial t} = D\frac{\partial^2 C_3}{\partial x^2} - v\frac{\partial C_3}{\partial x} + d_{13}\lambda_1 R_1 C_1 + d_{23}\lambda_2 R_2 C_2 - \lambda_3 R_3 C_3 \tag{19}$$

where: subscript 3 denotes the second progeny radionuclide; d_{13} = fraction of parent radionuclide transitions that result in production of the second progeny radionuclide; and d_{23} = fraction of the first progeny radionuclide transitions that result in production of the second progeny radionuclide. The characteristic equations for Equation (19), again conservatively neglecting hydrodynamic dispersion can be derived as:

$$\frac{\partial C_3}{\partial t} = d_{13}\lambda_1^{'} C_1 + d_{23}\lambda_2^{'} C_2 - \lambda_3 C_3 \tag{20}$$

$$\frac{\partial x}{\partial t} = \frac{v}{R_3} \tag{21}$$

where: $\lambda_1^{'} = \lambda_1 R_1/R_3$ and $\lambda_2^{'} = \lambda_2 R_2/R_3$. These equations can be integrated to yield:

$$C_3(t) = K_1 \exp(-\lambda_1^{'} t) + K_2 \exp(-\lambda_2^{'} t) + K_3 \exp(-\lambda_3 t) \tag{22}$$

where: $t = R_3L/v$ and for which

$$K_1 = \frac{d_{13}\lambda_3 C_{10}}{\lambda_3 - \lambda_1^{'}} + \frac{d_{23}\lambda_2^{'} d_{12}\lambda_3 C_{10}}{(\lambda_3 - \lambda_1^{'})(\lambda_2^{'} - \lambda_1^{'})}$$

$$K_2 = \frac{d_{23}\lambda_3 C_{20}}{\lambda_3 - \lambda_2^{'}} - \frac{d_{23}\lambda_2^{'} d_{12}\lambda_3 C_{10}}{(\lambda_3 - \lambda_2^{'})(\lambda_2^{'} - \lambda_1^{'})}$$

$$K_3 = C_{30} - \frac{d_{13}\lambda_3 C_{10}}{\lambda_3 - \lambda_1^{'}} - \frac{d_{23}\lambda_3 C_{20}}{\lambda_3 - \lambda_2^{'}} + \frac{d_{23}\lambda_2^{'} d_{12}\lambda_3 C_{10}}{(\lambda_3 - \lambda_1^{'})(\lambda_3 - \lambda_2^{'})}$$

Retardation factors were calculated using Equation (2) with the minimum site-specific distribution coefficients, an effective porosity of 0.001 and a bulk density of 2 .4 g/cm^3.

The results of the screening analysis for each path are presented in Tables 2.4-238 and 2.4-239.

The computed concentrations were compared with the 10 CFR 20, Appendix B, Table 2, ECLs. The ratio of the groundwater concentration to the ECL was used as the screening indicator. Ratios that were greater than or equal to 0.01, which means that the groundwater concentration is predicted to be greater than or equal to one percent of the ECL, were selected for further evaluation using adsorption, advection, and dispersion. The results for Lake Erie where the ratio exceeds 0.01 are highlighted in Table 2.4-238. The results for the nearest offsite well where the ratio exceeds 0.01 are highlighted in Table 2.4-239.

2.4.13.2.3.3 Transport Considering Radioactive Decay, Adsorption and Dilution in Lake Erie

Dilution between where the contaminated groundwater enters Lake Erie and the closest potable water source was considered. The nearest potable water intake for Lake Erie is approximately 1600 meters from the point where contaminated groundwater is expected to enter the lake. The lake depth varies, near the vicinity of the shoreline; a representative water depth of 2.2 meters is used. The nearest potable water intake is the Wilfred L. LePage Pumping Station 30" intake which is 474 meters offshore. These parameters give a lake volume between where the groundwater enters the lake and nearest potable water intake of more than 1,600,000 m^3. This volume would provide a dilution factor of approximately 3500. However, to be conservative, a dilution factor of 10 is applied for the nearest potable water intake in Lake Erie.

The results for Lake Erie applying the conservative dilution factor are provided in Table 2.4-240. The results show the predicted concentration of each of the radionuclides is less than the associated maximum permissible concentration and that the sum of fractions of all of the radionuclides is a maximum of 0.29 at 0.65 years; i.e., less than 1.0. Therefore, further evaluation for the release to the lake is not necessary.

2.4.13.2.3.4 Transport to the Closest Offsite Well Considering Radioactive Decay, Adsorption, Advection and Longitudinal Dispersion

The three radionuclides with the largest ECL fractions are considered to disperse in this analysis; i.e., H-3, Ni-63 and Pu-239.

The representative average linear velocity is considered to best represent subsurface site conditions in the one dimensional (longitudinal) sense along a groundwater pathline for each aquifer. The radionuclides of concern identified by the prior analyses are further evaluated in the next step, considering radioactive decay, adsorption, retardation, advection and dispersion using the pathway specific travel times.

Assuming a constant input concentration for a period of time t_0, the concentration along a groundwater pathline may be given by (Reference 2.4-318):

$$\begin{aligned} \frac{C(x,t)}{C_0} &= A(x,t) \quad 0 < t \leq t_0 \\ \frac{C(x,t)}{C_0} &= A(x,t) - A(x,t-t) \quad t > t_0 \end{aligned} \qquad (23)$$

where:

$$\begin{aligned} A(x,t) = {} & \frac{v}{v+U}\exp\left[\frac{x(v-U)}{2D}\right] erfc\left[\frac{Rx-Ut}{2(DRt)^{1/2}}\right] \\ & + \frac{v}{v-U}\exp\left[\frac{x(v+U)}{2D}\right] erfc\left[\frac{Rx+Ut}{2(DRt)^{1/2}}\right] \\ & + \frac{v^2}{2DR\lambda}\exp\left[\frac{xv}{D} - \lambda t\right] erfc\left[\frac{Rx+vt}{2(DRt)^{1/2}}\right] \end{aligned} \qquad (24)$$

with

$$U = (v^2 + 4DR\lambda)^{1/2} \qquad (25)$$

Definitions for the parameters in the above equations are as follows:

C = radionuclide concentration (µCi/cm^3)

C_0 = radionuclide input concentration (µCi/cm^3)

t_0 = period of time a radionuclide is input at C_0 (y)

v = average pore water velocity (ft/y)

D = longitudinal coefficient of hydrodynamic dispersion (ft^2/y)

R = retardation factor

λ = radioactive decay constant (y^{-1})

The parameters to be specified in Equations (23) and (24) include C_0, t_0, v, D, R, and λ. The basis for assigning these parameters is described below.

The radionuclide input concentration C_0 is assumed to be the concentration in the equipment drain collection tank room. The input concentration of Pu-239 (a daughter product of Np-239) is estimated by assuming all source Np-239 decays instantaneously to Pu-239. This is a reasonable assumption considering the half-life of Np-239 is small relative to the transport time scales of interest. The input concentration for Pu-239 was calculated using the relationship between the activity concentration and atom density.

$$C = \lambda N \tag{26}$$

where N is the atom density ($atoms/cm^3$).

The input time period t_0 is taken to be the operating life of the plant or 60 years (40 years initial operating license plus 20 years license renewal). This assumption is conservative in that the equipment drain collection tank room is taken to provide a constant concentration source term continuously for the entire plant operating life. At the end of plant operation, it is assumed that the tank is drained and that the continuous constant source ceases at that point in time.

The predicted concentrations of the radionuclides from the analysis of the closest offsite well pathway using site-specific input conditions and one-dimensional dispersion are summarized in Table 2.4-241. Note that dispersion is only considered for H-3, Ni-63 and Pu-239, while decay and adsorption (where applicable) are considered for the other radionuclides. Although no radionuclides exceed their ECLs, the sum of the fractions of all radionuclides slightly exceeds unity (i.e., 1.029) at 3 years.

2.4.13.2.3.5 Transport to the Closest Offsite Well Considering Radioactive Decay, Adsorption, Advection Including Longitudinal and Transverse Horizontal Dispersion

The three radionuclides with the largest ECL fractions are considered to disperse in this step of the analysis; i.e., H-3, Ni-63 and Pu-239.

From Reference 2.4-318 if a homogeneous, isotropic porous medium having a unidirectional steady state flow with seepage velocity v is considered and if a Cartesian coordinate system is chosen with the x axis oriented along the direction of flow and if the magnitude of the dispersion coefficients in that direction and orthogonal to it are defined by D_L and D_T, respectively, then the two dimensional (longitudinal and transverse horizontal) advection-dispersion equation, as follows, can be used:

$$D_L \frac{\partial^2 C}{\partial x^2} + D_T \frac{\partial^2 C}{\partial y^2} - v\frac{\partial C}{\partial x} - \lambda RC = R\frac{\partial C}{\partial t} \qquad (27)$$

where R is the retardation factor for the given type solute.

If the medium is assumed to be initially free of a particular solute species and at a certain time a strip type source with length 2a, orthogonal to the groundwater flow direction, is introduced along the y axis and if the concentration of the solute diminishes exponentially with time, the initial and boundary conditions of this mathematical model may be written as

$$\begin{aligned} &C(0,y,t) = C_0 e^{-\alpha t} && -a \le y \le a \\ &C(0,y,t) = 0 && \text{other values of y} \end{aligned} \qquad (28)$$

$$\lim_{y\to\pm\infty} \frac{\partial C}{\partial y} = 0 \qquad \lim_{x\to\pm\infty} \frac{\partial C}{\partial x} = 0 \qquad (29)$$

An analytical solution (Reference 2.4-321) to the above model may be presented as:

$$C(x,y,t) = \frac{C_0 x}{4(\pi D_L)^{1/2}} \exp\left(\frac{vx}{2D_L} - \alpha t\right)$$
$$* \int_0^{t/R} \exp\left[-\left(\lambda R - \alpha R + \frac{v^2}{4D_L}\right)\tau - \frac{x^2}{4D_L\tau}\right]\tau^{-3/2} \qquad (30)$$
$$* \left[erf\left(\frac{a-y}{2(D_T\tau)^{1/2}}\right) + erf\left(\frac{a+y}{2(D_T\tau)^{1/2}}\right)\right] d\tau$$

The integral is determined by numerical methods.

The predicted concentrations of the radionuclides from the analysis of the closest offsite well pathway using site-specific input conditions and two-dimensional dispersion are summarized in Table 2.4-242. Note that dispersion is only considered for H-3, Ni-63 and Pu-239, while decay and adsorption (where applicable) are considered for the other radionuclides. No radionuclides exceed their ECLs and the sum of the fractions of all radionuclides is less than unity at all time points.

2.4.13.3.4 Compliance with 10 CFR 20

As described above, the concentrations of the radionuclides predicted at both the potable water intake in Lake Erie and the closest off site well are less than the limits in 10 CFR 20, Appendix B, Table 2, Column 2. Meeting 10 CFR 20 limits at the closest off site well demonstrates that the radiological consequences of a postulated failure of one of the equipment drain collection tanks are also acceptable for larger distances from the radwaste building.

10 CFR 20, Appendix B, Table 2 imposes additional requirements when the identity and concentration of each radionuclide in a mixture are known. In this case, the ratio present in the mixture and the concentration otherwise established in 10 CFR 20 for the specified radionuclides not in a mixture must be determined. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity"). The sum of fractions approach has been applied to the radionuclide concentrations for both pathways. As described above, the sum of fractions for the mixtures at the closest off site well and at the potable water intake in Lake Erie are less than unity.

10 CFR 20, Appendix B states, 'The columns in Table 2 of this appendix captioned "Effluents," "Air," and "Water," are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of §20.1302. The concentration values given in Columns 1 and 2 of Table 2 are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem or 0.5 millisieverts)." Thus, meeting the concentration limits of 10 CFR 20, Appendix B, Table 2, Column 2 results in a dose of less than 0.05 rem and therefore demonstrates that the requirements of 10 CFR 20.1301 and 10 CFR 20.1302 are met.

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Table 2.4-234 Site Specific ~~RESRAD-OFFSITE~~ Inputs ~~(Sheet 1 of 2)~~ [EF3 COL 2.0-24-A]

Parameter	Description	Value
Cerium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	4575
Cesium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	1078
Cobalt Kd (cm^3/g)	Radionuclide-specific distribution coefficient	640
Iron Kd (cm^3/g)	Radionuclide-specific distribution coefficient	2.88
Manganese Kd (cm^3/g)	Radionuclide-specific distribution coefficient	394
Ruthenium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	42.9
Silver Kd (cm^3/g)	Radionuclide-specific distribution coefficient	0.41
Strontium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	0.44
Yttrium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	3183
Zinc Kd (cm^3/g)	Radionuclide-specific distribution coefficient	16.7
~~Total porosity (unitless)~~	~~Total soil porosity, which is the ratio of the soil pore volume to the total volume~~	~~0.25~~
Effective porosity (unitless)	The amount of interconnected pore space through which fluids can pass, expressed as a percent of bulk volume	~~0.01~~ 0.001
Hydraulic conductivity (m/yr) (ft/day)	A coefficient of proportionality describing the rate at which water can move through a permeable medium	~~197,719~~ 365.16 (3.28)
Hydraulic gradient to surface water body and off site well (unitless)	Change in groundwater elevation per unit of distance in the direction of groundwater flow to a surface water body or off site well.	0.002
Distance to the nearest off site water well not in a restricted area (ft. (m))	Distance to the nearest off-site water well	4373 (1333)
Distance to the nearest surface water body (Lake Erie) (ft. (m))	Distance to the nearest off-site surface water body that contributes to a potable drinking water source	1554 (474)
~~Precipitation (m/yr)~~	~~Site annual average precipitation~~	~~0.892~~
Dry bulk density (gm/cm^3)	Mass of (dry) solids in a unit volume of soil. A range of average dry bulk densities was determined based on tests.	1.68 – 2.4

Table 2.4-234 Site Specific RESRAD-OFFSITE Inputs (Sheet 2 of 2) [EF3 COL 2.0-24-A]

Parameter	Description	Value
Longitudinal Dispersivity to Lake Erie (m)	Ratio between the longitudinal dispersion coefficient and pore water velocity with a dimension of length. This value is based on the aquifer materials and the distance downgradient from the contaminant source.	8.21
Transverse Horizontal Dispersivity to Lake Erie (m)	Ratio between the horizontal lateral dispersion coefficient and pore water velocity with a dimension of length. This value is based on the aquifer materials and the distance downgradient from the contaminant source.	1.03
Longitudinal Dispersivity to off site well (m)	Ratio between the longitudinal dispersion coefficient and pore water velocity with a dimension of length. This value is based on the aquifer materials and the distance downgradient from the contaminant source.	11.77
Transverse Horizontal Dispersivity to off site well (m)	Ratio between the horizontal lateral dispersion coefficient and pore water velocity with a dimension of length. This value is based on the aquifer materials and the distance downgradient from the contaminant source.	3.30

Table 2.4-235 Comparison of Liquid Release Concentrations With 10 CFR 20 Concentrations - Off Site Water Well (Sheet 1 of 2) [EF3 COL 2.0-24-A]

Replace with new Table 2.4-235 insert, attached.

Nuclide	Maximum Concentration (µCi/ml)	10 CFR 20 Concentration (µCi/ml)	Max Concentration / 10 CFR Limit
Ac-227	1.10E-31	5.00E-09	2.21E-23
Ag-110m	5.76E-09	6.00E-06	9.59E-04
Ba-140	6.95E-07	8.00E-06	8.68E-02
Co-60	2.55E-20	3.00E-06	8.49E-15
Cr-51	2.20E-05	5.00E-04	4.40E-02
Cs-134	5.30E-46	9.00E-07	5.88E-40
Cs-137	4.38E-14	1.00E-06	4.38E-08
Cu-64	1.72E-13	2.00E-04	8.62E-10
Fe-55	1.03E-06	1.00E-04	1.03E-02
Fe-59	3.93E-11	1.00E-05	3.93E-06
Fr-223	1.52E-33	8.00E-06	1.90E-28
H-3	2.44E-06	1.00E-03	2.44E-03
I-129	[illegible]	2.00E-07	2.28E-08
I-132	[illegible]	1.00E-04	6.42E-06
La-140	[illegible]	9.00E-06	8.80E-02
Mn-54	8.56E-42	3.00E-05	2.85E-37
Mo-99	6.63E-08	2.00E-05	3.31E-03
Na-24	1.08E-12	5.00E-05	2.16E-08
Nb-93m	1.89E-16	2.00E-04	9.46E-13
Nb-95	2.43E-07	3.00E-05	8.09E-03
Nb-95m	1.46E-09	3.00E-05	4.88E-05
Ni-63	9.01E-08	1.00E-04	9.01E-04
Np-239	1.38E-07	2.00E-05	6.90E-03
P-32	8.78E-08	9.00E-06	9.75E-03
Pa-231	9.48E-28	6.00E-09	1.58E-19
Pb-211	4.55E-33	2.00E-04	2.28E-29
Pr-144	5.43E-12	2.00E-05	2.71E-07
Pu-239	5.45E-12	2.00E-08	2.72E-04
Ra-223	4.59E-33	1.00E-07	4.59E-26
Re-187	1.84E-20	8.00E-03	2.31E-18

Table 2.4-235 Comparison of Liquid Release Concentrations With 10 CFR 20 Concentrations - Off Site Water Well (Sheet 2 of 2) [EF3 COL 2.0-24-A]

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration / 10 CFR Limit
Rh-103m	4.16E-10	6.00E-03	6.93E-08
Ru-103	7.41E-38	3.00E-05	2.47E-33
Ru-106	1.03E-14	3.00E-06	3.44E-09
Sr-89	7.72E-08	8.00E-06	9.65E-03
Sr-90	6.33E-08	5.00E-07	1.27E-01
Sr-91	3.31E-41	2.00E-05	1.66E-36
Tc-99	2.08E-13	6.00E-05	3.47E-09
Tc-99m	6.39E-08	1.00E-03	6.39E-05
Te-129	2.77E-07	4.00E-04	6.93E-04
Te-129m	4.26E-07	7.00E-06	6.08E-02
Te-132	6.23E-10	9.00E-06	6.92E-05
Th-227	2.01E-32	2.00E-06	1.01E-26
Th-231	1.39E-21	5.00E-05	2.78E-17
U-235	1.40E-21	3.00E-07	4.67E-15
W-187	2.18E-11	3.00E-05	7.28E-07
Zn-65	3.84E-10	5.00E-06	7.69E-05
Zr-93	1.06E-14	4.00E-05	2.65E-10
Zr-95	2.07E-07	2.00E-05	1.03E-02
	SUM of FRACTIONS		**4.70E-01**

Table 2.4-236 Comparison of Liquid Release Concentrations With 10 CFR 20 Concentrations - Lake Erie (Sheet 1 of 2) [EF3 COL 2.0-24-A]

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration / 10 CFR Limit
Ac-227	9.35E-23	5.00E-09	1.87E-14
Ag-110m	4.98E-09	6.00E-06	8.30E-04
Ba-140	4.50E-08	8.00E-06	5.62E-03
Co-60	1.63E-13	3.00E-06	5.43E-08
Cr-51	2.58E-06	5.00E-04	5.16E-03
Cs-134	9.85E-24	9.00E-07	1.09E-17
Cs-137	2.19E-11	1.00E-06	2.19E-05
Cu-64	3.38E-12	2.00E-04	1.69E-08
Fe-55	1.96E-06	1.00E-04	1.96E-02
Fe-59	4.09E-10	1.00E-05	4.09E-05
Fr-223	1.29E-24	8.00E-06	1.61E-19
H-3	1.90E-06	1.00E-03	1.90E-03
I-129	5.63E-1[illegible]	[illegible]-07	2.82E-08
I-132	4.00E-[illegible]	[illegible]-04	4.00E-07
I-134	3.44E-[illegible]	[illegible]-04	8.61E-30
La-140	5.05E-08	9.00E-06	5.61E-03
Mn-54	3.98E-22	3.00E-05	1.33E-17
Mo-99	4.77E-09	2.00E-05	2.38E-04
Na-24	7.06E-12	5.00E-05	1.41E-07
Nb-93m	5.46E-17	2.00E-04	2.73E-13
Nb-95	8.80E-08	3.00E-05	2.93E-03
Nb-95m	3.98E-10	3.00E-05	1.33E-05
Ni-63	7.25E-08	1.00E-04	7.25E-04
Np-239	1.18E-08	2.00E-05	5.90E-04
P-32	6.19E-09	9.00E-06	6.88E-04
Pa-231	9.35E-23	6.00E-09	1.56E-14
Pb-211	9.35E-23	2.00E-04	4.68E-19
Pr-144	2.77E-16	2.00E-05	1.39E-11
Pu-239	4.31E-12	2.00E-08	2.15E-04
Ra-223	9.35E-23	1.00E-07	9.35E-16

Replace with new Table 2.4-236 insert, attached.

Table 2.4-236 Comparison of Liquid Release Concentrations With 10 CFR 20 Concentrations - Lake Erie (Sheet 2 of 2)

[EF3 COL 2.0-24-A]

Nuclide	Maximum Concentration (µCi/ml)	10 CFR 20 Concentration (µCi/ml)	Max Concentration / 10 CFR Limit
Re-187	1.40E-20	8.00E-03	1.75E-18
Rh-103m	1.19E-13	6.00E-03	1.98E-11
Ru-103	3.52E-21	3.00E-05	1.17E-16
Ru-106	6.60E-12	3.00E-06	2.20E-06
Sr-89	4.99E-08	8.00E-06	6.24E-03
Sr-90	1.23E-07	5.00E-07	2.47E-01
Sr-91	9.50E-23	2.00E-05	4.75E-18
Sr-92	1.03E-45	4.00E-05	2.56E-41
Tc-99	1.66E-13	6.00E-05	2.77E-09
Tc-99m	4.60E-09	1.00E-03	4.60E-06
Te-129	3.82E-08	4.00E-04	9.56E-05
Te-129m	5.88E-08	7.00E-06	8.39E-03
Te-132	3.88E-11	9.00E-06	4.31E-06
Th-227	9.22E-23	2.00E-06	4.61E-17
Th-231	4.78E-21	5.00E-05	9.55E-17
U-235	4.79E-21	3.00E-07	1.60E-14
W-187	1.46E-11	3.00E-05	4.87E-07
Y-90	1.22E-07	7.00E-06	1.74E-02
Y-91	3.08E-23	8.00E-06	3.85E-18
Y-91m	5.49E-23	2.00E-03	2.74E-20
Y-92	1.02E-45	4.00E-05	2.55E-41
Zn-65	1.83E-08	5.00E-06	3.66E-03
Zr-93	9.70E-16	4.00E-05	2.42E-11
Zr-95	5.39E-08	2.00E-05	2.69E-03
	SUM of FRACTIONS		**3.29E-01**

Table 2.4-235 Lake Erie – Decay Only

		Decay Only Concentrations At Lake (µCi/ml)								Decay Only GW/ECL at Lake						
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	Progeny	0.65	1	1.83	2	3	5	6		0.65	1	1.83	2	3	5	6
H-3		8.452E-04	8.766E-04	7.910E-04	7.835E-04	7.407E-04	6.621E-04	6.259E-04		8.452E-01	8.766E-01	7.910E-01	7.835E-01	7.407E-01	6.621E-01	6.259E-01
Na-24																
P-32		1.793E-09	3.651E-12							1.992E-04	4.057E-07					
Cr-51		6.184E-05	2.523E-06	1.281E-09	2.708E-10	2.906E-14				1.237E-01	5.046E-03	2.561E-06	5.415E-07	5.811E-11		
Mn-54		5.235E-04	3.944E-04	2.016E-04	1.757E-04	7.823E-05	1.552E-05	6.911E-06		1.745E+01	1.315E+01	6.718E+00	5.855E+00	2.608E+00	5.172E-01	2.304E-01
Mn-56																
Fe-55		2.348E-02	2.146E-02	1.734E-02	1.660E-02	1.284E-02	7.685E-03	5.945E-03		2.348E+02	2.146E+02	1.734E+02	1.660E+02	1.284E+02	7.685E+01	5.945E+01
Fe-59		8.525E-06	1.164E-06	1.036E-08	3.937E-09	1.331E-11				8.525E-01	1.164E-01	1.036E-03	3.937E-04	1.331E-06		
Co-58		1.551E-04	4.438E-05	2.282E-06	1.242E-06	3.477E-08	2.724E-11	7.626E-13		7.757E+00	2.219E+00	1.141E-01	6.211E-02	1.739E-03	1.362E-06	3.813E-08
Co-60		5.170E-03	4.938E-03	4.429E-03	4.331E-03	3.799E-03	2.922E-03	2.563E-03		1.723E+03	1.646E+03	1.476E+03	1.444E+03	1.266E+03	9.741E+02	8.543E+02
Ni-63		2.905E-05	2.898E-05	2.881E-05	2.877E-05	2.856E-05	2.816E-05	2.795E-05		2.905E-01	2.898E-01	2.881E-01	2.877E-01	2.856E-01	2.816E-01	2.795E-01
Cu-64																
Zn-65		1.216E-02	8.459E-03	3.575E-03	2.997E-03	1.062E-03	1.333E-04	4.723E-05		2.432E+03	1.692E+03	7.150E+02	5.994E+02	2.124E+02	2.666E+01	9.446E+00
Rb-89																
	Sr-89	4.952E-05	8.566E-06	1.335E-07	5.695E-08	3.787E-10	1.674E-14			6.190E+00	1.071E+00	1.669E-02	7.119E-03	4.733E-05	2.093E-09	
Sr-90		1.978E-04	1.962E-04	1.923E-04	1.915E-04	1.870E-04	1.783E-04	1.741E-04		3.956E+02	3.923E+02	3.846E+02	3.831E+02	3.740E+02	3.566E+02	3.482E+02
	Y-90	1.978E-04	1.962E-04	1.923E-04	1.915E-04	1.870E-04	1.783E-04	1.741E-04		2.826E+01	2.802E+01	2.747E+01	2.736E+01	2.672E+01	2.547E+01	2.487E+01
Sr-91																
	Y-91m															
	Y-91	3.417E-05	7.513E-06	2.069E-07	9.915E-08	1.309E-09	2.279E-13	3.008E-15		4.271E+00	9.391E-01	2.587E-02	1.239E-02	1.636E-04	2.849E-08	3.760E-10
Sr-92																
	Y-92															
Y-93																
Zr-95		9.228E-06	2.311E-06	8.667E-08	4.424E-08	8.469E-10	3.103E-13	5.941E-15		4.614E-01	1.155E-01	4.333E-03	2.212E-03	4.234E-05	1.552E-08	2.970E-10
	Nb-95m	6.845E-08	1.714E-08	6.430E-10	3.282E-10	6.282E-12	2.302E-15			2.282E-03	5.715E-04	2.143E-05	1.094E-05	2.094E-07	7.674E-11	
	Nb-95	1.875E-05	4.995E-06	1.923E-07	9.824E-08	1.883E-09	6.899E-13	1.321E-14		6.249E-01	1.665E-01	6.410E-03	3.275E-03	6.276E-05	2.300E-08	4.403E-10
Mo-99																
	Tc-99m															
Ru-103		3.270E-06	3.430E-07	1.634E-09	5.465E-10	8.707E-13				1.090E-01	1.143E-02	5.446E-05	1.822E-05	2.902E-08		
	Rh-103m	3.263E-06	3.423E-07	1.631E-09	5.454E-10	8.689E-13				5.439E-04	5.706E-05	2.718E-07	9.090E-08	1.448E-10		
Ru-106		4.706E-05	3.699E-05	2.090E-05	1.859E-05	9.345E-06	2.360E-06	1.186E-06		1.569E+01	1.233E+01	6.966E+00	6.198E+00	3.115E+00	7.868E-01	3.955E-01
	Rh-106	4.706E-05	3.699E-05	2.090E-05	1.859E-05	9.345E-06	2.360E-06	1.186E-06								
Ag-110m		1.245E-05	8.737E-06	3.770E-06	3.174E-06	1.153E-06	1.521E-07	5.525E-08		2.076E+00	1.456E+00	6.283E-01	5.290E-01	1.921E-01	2.535E-02	9.209E-03
	Ag-110	1.656E-07	1.162E-07	5.014E-08	4.221E-08	1.533E-08	2.023E-09	7.349E-10								
Te-129m		2.885E-06	2.064E-07	3.969E-10	1.103E-10	5.889E-14				4.121E-01	2.949E-02	5.671E-05	1.575E-05	8.413E-09		
	Te-129	1.878E-06	1.344E-07	2.584E-10	7.177E-11	3.834E-14				4.694E-03	3.359E-04	6.459E-07	1.794E-07	9.584E-11		
Te-131m																
	Te-131															
	I-131	8.029E-12								8.029E-06						
Te-132																

		Decay Only Concentrations At Lake (µCi/ml)								Decay Only GW/ECL at Lake						
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**		**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**
	I-132															
I-133																
	Xe-133m															
	Xe-133															
I-134																
I-135																
	Xe-135m															
	Xe-135															
Cs-134		5.329E-04	4.737E-04	3.584E-04	3.385E-04	2.418E-04	1.234E-04	8.820E-05		5.921E+02	5.264E+02	3.982E+02	3.761E+02	2.687E+02	1.372E+02	9.800E+01
Cs-136		2.288E-10	2.641E-13							3.813E-05	4.402E-08					
Cs-137		1.855E-03	1.840E-03	1.805E-03	1.798E-03	1.757E-03	1.678E-03	1.640E-03		1.855E+03	1.840E+03	1.805E+03	1.798E+03	1.757E+03	1.678E+03	1.640E+03
	Ba-137m	1.755E-03	1.741E-03	1.708E-03	1.701E-03	1.662E-03	1.588E-03	1.551E-03								
Cs-138																
Ba-140		3.718E-09	3.468E-12							4.647E-04	4.336E-07					
	La-140	4.285E-09	3.997E-12							4.761E-04	4.441E-07					
Ce-141		1.692E-06	1.107E-07	1.723E-10	4.584E-11	1.897E-14				5.640E-02	3.691E-03	5.744E-06	1.528E-06	6.324E-10		
Ce-144		3.967E-05	2.904E-05	1.386E-05	1.191E-05	4.883E-06	8.210E-07	3.367E-07		1.322E+01	9.679E+00	4.618E+00	3.969E+00	1.628E+00	2.737E-01	1.122E-01
	Pr-144m	7.061E-07	5.169E-07	2.466E-07	2.119E-07	8.691E-08	1.461E-08	5.993E-09								
	Pr-144	3.967E-05	2.904E-05	1.386E-05	1.191E-05	4.883E-06	8.210E-07	3.367E-07		6.612E-02	4.840E-02	2.309E-02	1.985E-02	8.138E-03	1.368E-03	5.611E-04
W-187																
Np-239																
	Pu-239	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09		8.671E-02	8.671E-02	8.671E-02	8.671E-02	8.671E-02	8.670E-02	8.670E-02
									Sum of Fractions	**7.332E+03**	**6.382E+03**	**5.001E+03**	**4.812E+03**	**4.042E+03**	**3.278E+03**	**3.036E+03**

(1) Blank cells (i.e., no numerical results) represent results that are essentially zero.

Table 2.4-236 Off Site Well – Decay Only

		Decay Only Concentrations at Well (µCi/ml)						Decay Only GW/ECL at Well				
		Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**1.83**	**2**	**3**	**5**	**6**		**1.83**	**2**	**3**	**5**	**6**
H-3		7.910E-04	7.835E-04	7.407E-04	6.621E-04	6.259E-04		7.910E-01	7.835E-01	7.407E-01	6.621E-01	6.259E-01
Na-24												
P-32												
Cr-51		1.281E-09	2.708E-10	2.906E-14				2.561E-06	5.415E-07	5.811E-11		
Mn-54		2.016E-04	1.757E-04	7.823E-05	1.552E-05	6.911E-06		6.718E+00	5.855E+00	2.608E+00	5.172E-01	2.304E-01
Mn-56												
Fe-55		1.734E-02	1.660E-02	1.284E-02	7.685E-03	5.945E-03		1.734E+02	1.660E+02	1.284E+02	7.685E+01	5.945E+01
Fe-59		1.036E-08	3.937E-09	1.331E-11				1.036E-03	3.937E-04	1.331E-06		
Co-58		2.282E-06	1.242E-06	3.477E-08	2.724E-11	7.626E-13		1.141E-01	6.211E-02	1.739E-03	1.362E-06	3.813E-08
Co-60		4.429E-03	4.331E-03	3.799E-03	2.922E-03	2.563E-03		1.476E+03	1.444E+03	1.266E+03	9.741E+02	8.543E+02
Ni-63		2.881E-05	2.877E-05	2.856E-05	2.816E-05	2.795E-05		2.881E-01	2.877E-01	2.856E-01	2.816E-01	2.795E-01
Cu-64												
Zn-65		3.575E-03	2.997E-03	1.062E-03	1.333E-04	4.723E-05		7.150E+02	5.994E+02	2.124E+02	2.666E+01	9.446E+00
Rb-89												
	Sr-89	1.335E-07	5.695E-08	3.787E-10	1.674E-14			1.669E-02	7.119E-03	4.733E-05	2.093E-09	
Sr-90		1.923E-04	1.915E-04	1.870E-04	1.783E-04	1.741E-04		3.846E+02	3.831E+02	3.740E+02	3.566E+02	3.482E+02
	Y-90	1.923E-04	1.915E-04	1.870E-04	1.783E-04	1.741E-04		2.747E+01	2.736E+01	2.672E+01	2.547E+01	2.487E+01
Sr-91												
	Y-91m											
	Y-91	2.069E-07	9.915E-08	1.309E-09	2.279E-13	3.008E-15		2.587E-02	1.239E-02	1.636E-04	2.849E-08	3.760E-10
Sr-92												
	Y-92											
Y-93												
Zr-95		8.667E-08	4.424E-08	8.469E-10	3.103E-13	5.941E-15		4.333E-03	2.212E-03	4.234E-05	1.552E-08	2.970E-10
	Nb-95m	6.430E-10	3.282E-10	6.282E-12	2.302E-15			2.143E-05	1.094E-05	2.094E-07	7.674E-11	
	Nb-95	1.923E-07	9.824E-08	1.883E-09	6.899E-13	1.321E-14		6.410E-03	3.275E-03	6.276E-05	2.300E-08	4.403E-10
Mo-99												
	Tc-99m											
Ru-103		1.634E-09	5.465E-10	8.707E-13				5.446E-05	1.822E-05	2.902E-08		
	Rh-103m	1.631E-09	5.454E-10	8.689E-13				2.718E-07	9.090E-08	1.448E-10		
Ru-106		2.090E-05	1.859E-05	9.345E-06	2.360E-06	1.186E-06		6.966E+00	6.198E+00	3.115E+00	7.868E-01	3.955E-01
	Rh-106	2.090E-05	1.859E-05	9.345E-06	2.360E-06	1.186E-06						
Ag-110m		3.770E-06	3.174E-06	1.153E-06	1.521E-07	5.525E-08		6.283E-01	5.290E-01	1.921E-01	2.535E-02	9.209E-03
	Ag-110	5.014E-08	4.221E-08	1.533E-08	2.023E-09	7.349E-10						
Te-129m		3.969E-10	1.103E-10	5.889E-14				5.671E-05	1.575E-05	8.413E-09		
	Te-129	2.584E-10	7.177E-11	3.834E-14				6.459E-07	1.794E-07	9.584E-11		
Te-131m												
	Te-131											
	I-131											
Te-132												

		Decay Only Concentrations at Well (µCi/ml)						Decay Only GW/ECL at Well				
		Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**1.83**	**2**	**3**	**5**	**6**		**1.83**	**2**	**3**	**5**	**6**
	I-132											
I-133												
	Xe-133m											
	Xe-133											
I-134												
I-135												
	Xe-135m											
	Xe-135											
Cs-134		3.584E-04	3.385E-04	2.418E-04	1.234E-04	8.820E-05		3.982E+02	3.761E+02	2.687E+02	1.372E+02	9.800E+01
Cs-136												
Cs-137		1.805E-03	1.798E-03	1.757E-03	1.678E-03	1.640E-03		1.805E+03	1.798E+03	1.757E+03	1.678E+03	1.640E+03
	Ba-137m	1.708E-03	1.701E-03	1.662E-03	1.588E-03	1.551E-03						
Cs-138												
Ba-140												
	La-140											
Ce-141		1.723E-10	4.584E-11	1.897E-14				5.744E-06	1.528E-06	6.324E-10		
Ce-144		1.386E-05	1.191E-05	4.883E-06	8.210E-07	3.367E-07		4.618E+00	3.969E+00	1.628E+00	2.737E-01	1.122E-01
	Pr-144m	2.466E-07	2.119E-07	8.691E-08	1.461E-08	5.993E-09						
	Pr-144	1.386E-05	1.191E-05	4.883E-06	8.210E-07	3.367E-07		2.309E-02	1.985E-02	8.138E-03	1.368E-03	5.611E-04
W-187												
Np-239												
	Pu-239	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09		8.671E-02	8.671E-02	8.671E-02	8.670E-02	8.670E-02
							Sum of Fractions	**5.001E+03**	**4.812E+03**	**4.042E+03**	**3.278E+03**	**3.036E+03**

(1) Blank cells (i.e., no numerical results) represent results that are essentially zero.

Table 2.4-238 Lake Erie – Decay Plus Retardation

		Decay Plus Retardation Concentrations At Lake (µCi/ml)								Decay Plus Retardation GW/ECL at Lake						
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**		**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**
H-3		8.452E-04	8.287E-04	7.910E-04	7.835E-04	7.407E-04	6.621E-04	6.259E-04		8.452E-01	8.287E-01	7.910E-01	7.835E-01	7.407E-01	6.621E-01	6.259E-01
Na-24																
P-32		1.793E-09	3.651E-12							1.992E-04	4.057E-07					
Cr-51		6.184E-05	2.523E-06	1.281E-09	2.708E-10	2.906E-14				1.237E-01	5.046E-03	2.561E-06	5.415E-07	5.811E-11		
Mn-54																
Mn-56																
Fe-55																
Fe-59																
Co-58																
Co-60																
Ni-63		2.905E-05	2.898E-05	2.881E-05	2.877E-05	2.856E-05	2.816E-05	2.795E-05		2.905E-01	2.898E-01	2.881E-01	2.877E-01	2.856E-01	2.816E-01	2.795E-01
Cu-64																
Zn-65																
Rb-89																
	Sr-89															
Sr-90		1.501E-11	2.183E-15							3.002E-05	4.365E-09					
	Y-90	1.501E-11	2.183E-15							2.144E-06	3.118E-10					
Sr-91																
	Y-91m															
	Y-91															
Sr-92																
	Y-92															
Y-93																
Zr-95		9.228E-06	2.311E-06	8.667E-08	4.424E-08	8.469E-10	3.103E-13	5.941E-15		4.614E-01	1.155E-01	4.333E-03	2.212E-03	4.234E-05	1.552E-08	2.970E-10
	Nb-95m	6.845E-08	1.714E-08	6.430E-10	3.282E-10	6.282E-12	2.302E-15			2.282E-03	5.715E-04	2.143E-05	1.094E-05	2.094E-07	7.674E-11	
	Nb-95	1.875E-05	4.995E-06	1.923E-07	9.824E-08	1.883E-09	6.899E-13	1.321E-14		6.249E-01	1.665E-01	6.410E-03	3.275E-03	6.276E-05	2.300E-08	4.403E-10
Mo-99																
	Tc-99m															
Ru-103																
	Rh-103m															
Ru-106																
	Rh-106															
Ag-110m																
	Ag-110															
Te-129m		2.885E-06	2.064E-07	3.969E-10	1.103E-10	5.889E-14				4.121E-01	2.949E-02	5.671E-05	1.575E-05	8.413E-09		
	Te-129	1.878E-06	1.344E-07	2.584E-10	7.177E-11	3.834E-14				4.694E-03	3.359E-04	6.459E-07	1.794E-07	9.584E-11		
Te-131m																
	Te-131															
	I-131	8.029E-12								8.029E-06						
Te-132																

		Decay Plus Retardation Concentrations At Lake (µCi/ml)								Decay Plus Retardation GW/ECL at Lake						
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**		**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**
	I-132															
I-133																
	Xe-133m															
	Xe-133															
I-134																
I-135																
	Xe-135m															
	Xe-135															
Cs-134																
Cs-136		2.288E-10	2.641E-13							3.813E-05	4.402E-08					
Cs-137																
	Ba-137m															
Cs-138																
Ba-140		3.718E-09	3.468E-12							4.647E-04	4.336E-07					
	La-140	4.285E-09	3.997E-12							4.761E-04	4.441E-07					
Ce-141		1.692E-06	1.107E-07	1.723E-10	4.584E-11	1.897E-14				5.640E-02	3.691E-03	5.744E-06	1.528E-06	6.324E-10		
Ce-144																
	Pr-144m															
	Pr-144															
W-187																
Np-239																
	Pu-239	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09		8.671E-02	8.671E-02	8.671E-02	8.671E-02	8.671E-02	8.670E-02	8.670E-02
									Sum of Fractions	**2.909E+00**	**1.526E+00**	**1.177E+00**	**1.163E+00**	**1.113E+00**	**1.030E+00**	**9.921E-01**

(1) Blank cells (i.e., no numerical results) represent results that are essentially zero.

Table 2.4-239 Off Site Well – Decay Plus Retardation

		Decay Plus Retardation Concentrations at Well (µCi/ml)						Decay Plus Retardation GW/ECL at Well				
		Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	Progeny	1.83	2	3	5	6		1.83	2	3	5	6
H-3		7.910E-04	7.835E-04	7.407E-04	6.621E-04	6.259E-04		7.910E-01	7.835E-01	7.407E-01	6.621E-01	6.259E-01
Na-24												
P-32												
Cr-51		1.281E-09	2.708E-10	2.906E-14				2.561E-06	5.415E-07	5.811E-11		
Mn-54												
Mn-56												
Fe-55												
Fe-59												
Co-58												
Co-60												
Ni-63		2.881E-05	2.877E-05	2.856E-05	2.816E-05	2.795E-05		2.881E-01	2.877E-01	2.856E-01	2.816E-01	2.795E-01
Cu-64												
Zn-65												
Rb-89												
	Sr-89											
Sr-90												
	Y-90											
Sr-91												
	Y-91m											
	Y-91											
Sr-92												
	Y-92											
Y-93												
Zr-95		8.667E-08	4.424E-08	8.469E-10	3.103E-13	5.941E-15		4.333E-03	2.212E-03	4.234E-05	1.552E-08	2.970E-10
	Nb-95m	6.430E-10	3.282E-10	6.282E-12	2.302E-15			2.143E-05	1.094E-05	2.094E-07	7.674E-11	
	Nb-95	1.923E-07	9.824E-08	1.883E-09	6.899E-13	1.321E-14		6.410E-03	3.275E-03	6.276E-05	2.300E-08	4.403E-10
Mo-99												
	Tc-99m											
Ru-103												
	Rh-103m											
Ru-106												
	Rh-106											
Ag-110m												
	Ag-110											
Te-129m		3.969E-10	1.103E-10	5.889E-14				5.671E-05	1.575E-05	8.413E-09		
	Te-129	2.584E-10	7.177E-11	3.834E-14				6.459E-07	1.794E-07	9.584E-11		
Te-131m												
	Te-131											
	I-131											
Te-132												

		Decay Plus Retardation Concentrations at Well (µCi/ml)						Decay Plus Retardation GW/ECL at Well				
		Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**1.83**	**2**	**3**	**5**	**6**		**1.83**	**2**	**3**	**5**	**6**
	I-132											
I-133												
	Xe-133m											
	Xe-133											
I-134												
I-135												
	Xe-135m											
	Xe-135											
Cs-134												
Cs-136												
Cs-137												
	Ba-137m											
Cs-138												
Ba-140												
	La-140											
Ce-141		1.723E-10	4.584E-11	1.897E-14				5.744E-06	1.528E-06	6.324E-10		
Ce-144												
	Pr-144m											
	Pr-144											
W-187												
Np-239												
	Pu-239	1.734E-09	1.734E-09	1.734E-09	1.734E-09	1.734E-09		8.671E-02	8.671E-02	8.671E-02	8.670E-02	8.670E-02
							Sum of Fractions	**1.177E+00**	**1.163E+00**	**1.113E+00**	**1.030E+00**	**9.921E-01**

(1) Blank cells (i.e., no numerical results) represent results that are essentially zero.

Table 2.4-240 Lake Erie – Decay Plus Retardation, Factor of 10 for Dilution

		Decay Plus Retardation Plus Dilution Concentrations At Lake (µCi/ml)								Decay Plus Retardation Plus Dilution GW/ECL at Lake						
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	**Progeny**	**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**		**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**
H-3		8.452E-05	8.287E-05	7.910E-05	7.835E-05	7.407E-05	6.621E-05	6.259E-05		8.452E-02	8.287E-02	7.910E-02	7.835E-02	7.407E-02	6.621E-02	6.259E-02
Na-24																
P-32		1.793E-10	3.651E-13							1.992E-05	4.057E-08					
Cr-51		6.184E-06	2.523E-07	1.281E-10	2.708E-11	2.906E-15				1.237E-02	5.046E-04	2.561E-07	5.415E-08	5.811E-12		
Mn-54																
Mn-56																
Fe-55																
Fe-59																
Co-58																
Co-60																
Ni-63		2.905E-06	2.898E-06	2.881E-06	2.877E-06	2.856E-06	2.816E-06	2.795E-06		2.905E-02	2.898E-02	2.881E-02	2.877E-02	2.856E-02	2.816E-02	2.795E-02
Cu-64																
Zn-65																
Rb-89																
	Sr-89															
Sr-90		1.501E-12								3.002E-06						
	Y-90	1.501E-12								2.144E-07						
Sr-91																
	Y-91m															
	Y-91															
Sr-92																
	Y-92															
Y-93																
Zr-95		9.228E-07	2.311E-07	8.667E-09	4.424E-09	8.469E-11	3.103E-14			4.614E-02	1.155E-02	4.333E-04	2.212E-04	4.234E-06	1.552E-09	
	Nb-95m	6.845E-09	1.714E-09	6.430E-11	3.282E-11	6.282E-13				2.282E-04	5.715E-05	2.143E-06	1.094E-06	2.094E-08		
	Nb-95	1.875E-06	4.995E-07	1.923E-08	9.824E-09	1.883E-10	6.899E-14	1.321E-15		6.249E-02	1.665E-02	6.410E-04	3.275E-04	6.276E-06	2.300E-09	4.403E-11
Mo-99																
	Tc-99m															
Ru-103																
	Rh-103m															
Ru-106																
	Rh-106															
Ag-110m																
	Ag-110															
Te-129m		2.885E-07	2.064E-08	3.969E-11	1.103E-11	5.889E-15				4.121E-02	2.949E-03	5.671E-06	1.575E-06	8.413E-10		
	Te-129	1.878E-07	1.344E-08	2.584E-11	7.177E-12	3.834E-15				4.694E-04	3.359E-05	6.459E-08	1.794E-08	9.584E-12		
Te-131m																
	Te-131															
	I-131	8.029E-13								8.029E-07						
Te-132																

		Decay Plus Retardation Plus Dilution Concentrations At Lake (µCi/ml)								Decay Plus Retardation Plus Dilution GW/ECL at Lake						
		Yrs	**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**		**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**
Nuclide	**Progeny**	**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**		**0.65**	**1**	**1.83**	**2**	**3**	**5**	**6**
	I-132															
I-133																
	Xe-133m															
	Xe-133															
I-134																
I-135																
	Xe-135m															
	Xe-135															
Cs-134																
Cs-136		2.288E-11	2.641E-14							3.813E-06	4.402E-09					
Cs-137																
	Ba-137m															
Cs-138																
Ba-140		3.718E-10	3.468E-13							4.647E-05	4.336E-08					
	La-140	4.285E-10	3.997E-13							4.761E-05	4.441E-08					
Ce-141		1.692E-07	1.107E-08	1.723E-11	4.584E-12	1.897E-15				5.640E-03	3.691E-04	5.744E-07	1.528E-07	6.324E-11		
Ce-144																
	Pr-144m															
	Pr-144															
W-187																
Np-239																
	Pu-239	1.734E-10	1.734E-10	1.734E-10	1.734E-10	1.734E-10	1.734E-10	1.734E-10		8.671E-03	8.671E-03	8.671E-03	8.671E-03	8.671E-03	8.670E-03	8.670E-03
									Sum of Fractions	**2.909E-01**	**1.526E-01**	**1.177E-01**	**1.163E-01**	**1.113E-01**	**1.030E-01**	**9.921E-02**

(1) Blank cells (i.e., no numerical results) are essentially zero.

(2) The above table shows the results out to six years; which are sufficient to show a decline in the radionuclide concentrations.

Table 2.4-241 Off Site Well - Decay Plus Retardation Plus 1-D Dispersion (H-3, Ni-63, Pu-239 Only)

		Decay Plus Retardation Plus 1-D Dispersion Concentrations At Well (µCi/ml)							Decay Plus Retardation Plus 1-D Dispersion GW/ECL at Well					
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	Progeny	1.83	2	3	4	5	6		1.83	2	3	4	5	6
H-3		4.023E-04	5.923E-04	7.407E-04	7.003E-04	6.620E-04	6.259E-04		4.023E-01	5.923E-01	7.407E-01	7.003E-01	6.620E-01	6.259E-01
Na-24														
P-32														
Cr-51		1.281E-09	2.708E-10	2.906E-14					2.561E-06	5.415E-07	5.811E-11			
Mn-54														
Mn-56														
Fe-55														
Fe-59														
Co-58														
Co-60														
Ni-63		1.465E-05	2.175E-05	2.856E-05	2.836E-05	2.816E-05	2.795E-05		1.465E-01	2.175E-01	2.856E-01	2.836E-01	2.816E-01	2.795E-01
Cu-64														
Zn-65														
Rb-89														
	Sr-89													
Sr-90														
	Y-90													
Sr-91														
	Y-91m													
	Y-91													
Sr-92														
	Y-92													
Y-93														
Zr-95		8.667E-08	4.424E-08	8.469E-10		3.103E-13	5.941E-15		4.333E-03	2.212E-03	4.234E-05		1.552E-08	2.970E-10
	Nb-95m	6.430E-10	3.282E-10	6.282E-12		2.302E-15			2.143E-05	1.094E-05	2.094E-07		7.674E-11	
	Nb-95	1.923E-07	9.824E-08	1.883E-09		6.899E-13	1.321E-14		6.410E-03	3.275E-03	6.276E-05		2.300E-08	4.403E-10
Mo-99														
	Tc-99m													
Ru-103														
	Rh-103m													
Ru-106														
	Rh-106													
Ag-110m														
	Ag-110													
Te-129m		3.969E-10	1.103E-10	5.889E-14					5.671E-05	1.575E-05	8.413E-09			
	Te-129	2.584E-10	7.177E-11	3.834E-14					6.459E-07	1.794E-07	9.584E-11			
Te-131m														
	Te-131													
	I-131													

		Decay Plus Retardation Plus 1-D Dispersion Concentrations At Well (µCi/ml)							**Decay Plus Retardation Plus 1-D Dispersion GW/ECL at Well**					
		Yrs	**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**		**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**	**Yrs**
Nuclide	**Progeny**	**1.83**	**2**	**3**	**4**	**5**	**6**		**1.83**	**2**	**3**	**4**	**5**	**6**
Te-132														
	I-132													
I-133														
	Xe-133m													
	Xe-133													
I-134														
I-135														
	Xe-135m													
	Xe-135													
Cs-134														
Cs-136														
Cs-137														
	Ba-137m													
Cs-138														
Ba-140														
	La-140													
Ce-141		1.723E-10	4.584E-11	1.897E-14					5.744E-06	1.528E-06	6.324E-10			
Ce-144														
	Pr-144m													
	Pr-144													
W-187														
Np-239														
	Pu-239	2.940E-11	4.370E-11	5.780E-11	5.780E-11	5.780E-11	5.780E-11		1.470E-03	2.185E-03	2.890E-03	2.890E-03	2.890E-03	2.890E-03
								Sum of Fractions	**5.611E-01**	**8.175E-01**	**1.029E+00**	**9.868E-01**	**9.465E-01**	**9.083E-01**

(1) Blank cells (i.e., no numerical results) are essentially zero.

Table 2.4-242 Off Site Well – Decay Plus Retardation Plus 2-D Dispersion (H-3, Ni-63, Pu-239 Only)

		Decay Plus Retardation Plus 2-D Dispersion Concentrations At Well (µCi/ml)							Decay Plus Retardation Plus 2-D Dispersion GW/ECL at Well					
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	Progeny	1.83	2	3	4	5	6		1.83	2	3	4	5	6
H-3		3.381E-05	4.797E-05	5.701E-05	5.390E-05	5.096E-05	4.817E-05		3.381E-02	4.797E-02	5.701E-02	5.390E-02	5.096E-02	4.817E-02
Na-24														
P-32														
Cr-51		1.281E-09	2.708E-10	2.906E-14					2.561E-06	5.415E-07	5.811E-11			
Mn-54														
Mn-56														
Fe-55														
Fe-59														
Co-58														
Co-60														
Ni-63		1.231E-06	1.762E-06	2.200E-06	2.185E-06	2.169E-06	2.154E-06		1.231E-02	1.762E-02	2.200E-02	2.185E-02	2.169E-02	2.154E-02
Cu-64														
Zn-65														
Rb-89														
	Sr-89													
Sr-90														
	Y-90													
Sr-91														
	Y-91m													
	Y-91													
Sr-92														
	Y-92													
Y-93														
Zr-95		8.667E-08	4.424E-08	8.469E-10	1.621E-11	3.103E-13	5.941E-15		4.333E-03	2.212E-03	4.234E-05	8.106E-07	1.552E-08	2.970E-10
	Nb-95m	6.430E-10	3.282E-10	6.282E-12	1.203E-13	2.302E-15			2.143E-05	1.094E-05	2.094E-07	4.009E-09	7.674E-11	
	Nb-95	1.923E-07	9.824E-08	1.883E-09	3.604E-11	6.899E-13	1.321E-14		6.410E-03	3.275E-03	6.276E-05	1.201E-06	2.300E-08	4.403E-10
Mo-99														
	Tc-99m													
Ru-103														
	Rh-103m													
Ru-106														
	Rh-106													
Ag-110m														
	Ag-110													
Te-129m		3.969E-10	1.103E-10	5.889E-14					5.671E-05	1.575E-05	8.413E-09			
	Te-129	2.584E-10	7.177E-11	3.834E-14					6.459E-07	1.794E-07	9.584E-11			
Te-131m														
	Te-131													
	I-131													

		Decay Plus Retardation Plus 2-D Dispersion Concentrations At Well (μCi/ml)							Decay Plus Retardation Plus 2-D Dispersion GW/ECL at Well					
		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs		Yrs	Yrs	Yrs	Yrs	Yrs	Yrs
Nuclide	Progeny	1.83	2	3	4	5	6		1.83	2	3	4	5	6
Te-132														
	I-132													
I-133														
	Xe-133m													
	Xe-133													
I-134														
I-135														
	Xe-135m													
	Xe-135													
Cs-134														
Cs-136														
Cs-137														
	Ba-137m													
Cs-138														
Ba-140														
	La-140													
Ce-141		1.723E-10	4.584E-11	1.897E-14					5.744E-06	1.528E-06	6.324E-10			
Ce-144														
	Pr-144m													
	Pr-144													
W-187														
Np-239														
	Pu-239	2.471E-12	3.540E-12	4.451E-12	4.451E-12	4.451E-12	4.451E-12		1.235E-04	1.770E-04	2.225E-04	2.225E-04	2.225E-04	2.225E-04
								Sum of Fractions	**5.708E-02**	**7.128E-02**	**7.934E-02**	**7.597E-02**	**7.287E-02**	**6.993E-02**

(1) Blank cells (i.e., no numerical results) are essentially zero.

(2) The above table shows the results out to six years; which are sufficient to show a decline in the radionuclide concentrations.

Markup of Detroit Edison COLA
(following 3 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA Part 3 ER. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

2.3.1.2.3.2 **Advective Transport**

Advective transport assumes that any release to the groundwater travels at the same velocity as groundwater flow. The groundwater flow velocity (or seepage velocity) is calculated from the following equation (Reference 2.3-102):

$$V = Ki/ n_e \qquad [Eq. 3]$$

where:

V = Average linear velocity (ft/day)
K = Hydraulic Conductivity (ft/day)
i = Hydraulic gradient (ft/ft)
n_e = Effective porosity (dimensionless)

The travel time from the source to the receptor is calculated by:

$$T = D/V \qquad [Eq. 4]$$

where:

T = Travel time (days)
D = Distance from source to receptor (ft)
V = Average linear groundwater velocity (ft/day)

Insert 1 here.

Groundwater velocity is locally dependent on hydraulic conductivity, hydraulic gradient, and porosity. Hydraulic conductivity is estimated from slug test and packer test data collected during the Fermi subsurface investigation, and is discussed in Subsection 2.3.1.2.2.4.1 and Subsection 2.3.1.2.2.4.2. Hydraulic gradient is estimated from Fermi 3 potentiometric surface maps (November water level maps were selected as being representative of site conditions). ~~No porosity field data was collected , so literature values were used. Seepage velocity calculations were performed using the high and low range estimates of porosity (10-25 percent for glacial till, 25 percent for rock fill, 1-20 percent for limestone/dolomite) to bracket the range of possible results (Reference 2.3-102 and Reference 2.3-103).~~

For a direct release to the rock fill overburden at Fermi 3, the following conditions are assumed. Hydraulic conductivity is 1170 ft/day based on the P-385 S slug test. The gradient is 0.0007, based on the November water table map (FSAR Appendix 2.4BB), and porosity is 25 percent for the rock fill. This results in a calculated flow velocity of 3.27 ft/day. Applying this velocity to the pathway distance of 820 ft to the overflow canal, the travel time is calculated to be 0.69 years (250 days). This assumes instantaneous delivery to the water table (i.e., no time to travel through the vadose zone from the surface).

For a direct release to the Bass Islands aquifer under present day potentiometric surface conditions, the following conditions are assumed:

Insert 1

Total porosity of rock fill was estimated to be 25%, which is typical of coarse gravel (Reference 2.4-287 and Reference 2.4-288). For the Bass Islands formation, site specific estimates for effective porosity formation were developed based on site measured parameters for hydraulic conductivity and Rock Quality Designation (RQD). The estimates for effective porosity range from 0.1% to 0.8%. For the purposes of this evaluation, a conservative value for effective porosity of 0.1% is used.

- The average gradient along the flowpath from Fermi 3 to the point that it leaves the site to the west is 0.002
- ~~Porosity~~ [Effective porosity] is assumed to be ~~one~~ [0.1] percent, the most conservative estimate

The highest hydraulic conductivity estimate for a packer test that did not indicate vertical leakage to adjacent zones was 17.57 ft/day (MW-395 D at 37 ft: it should be noted that this boring is near the cooling towers, not along the flowpath). The lowest hydraulic conductivity for a valid packer test is 0.11 ft/day (MW-383 D at 67 ft). Based on the maximum hydraulic conductivity estimate, the calculated velocity is ~~3.5~~ [35] ft/day. Based on the minimum hydraulic conductivity estimate, the calculated velocity is ~~0.02~~ [0.2] ft/day. Based on a pathway distance of 4756 ft, the two velocity estimates yield travel time estimates along this pathway to the offsite well west of the site ranging from ~~3.7 years to 652 years.~~ [0.37 years to 65 years.]

To evaluate the pre-development groundwater flow gradient, Figure 2.3-25 was reviewed and an eastward gradient of 0.001 was estimated near the Fermi plant. For a direct release to the Bass Islands formation under pre-development conditions with this gradient and the range of hydraulic conductivities discussed in the previous paragraph, calculated groundwater velocities range from ~~0.01 to 1.76~~ [0.1 to 17.6] ft/day. Based on this range of velocities, the estimated travel time for the 1476-ft pathway east to Lake Erie ranges from ~~2.3 years to 368 years.~~ [0.23 years to 40 years.]

2.3.1.2.4 **Groundwater Monitoring**

A limited groundwater level monitoring program at Fermi 2 is currently performed as part of the Radiological Environmental Monitoring Program (REMP). Fermi 2 has four groundwater wells included in its REMP which are monitored monthly for water levels and sampled quarterly for the radionuclides and sensitivities specified in the Offsite Dose Calculation Manual (ODCM) (Reference 2.3-104).

In addition, 16 groundwater monitoring wells have been installed around Fermi 1 in support of decommissioning activities. These are also sampled on a quarterly basis with samples assayed for tritium and gamma emitters for the sensitivities specified in the Fermi 2 ODCM.

Some of the existing Fermi 3 piezometers will be abandoned prior to construction activities due to anticipated earth work and heavy construction requirements. It is not anticipated that this will affect any future groundwater monitoring program. However, prior to the commencement of construction activities, the monitoring well network will be evaluated to determine if any significant data gaps are created by the abandonment of existing wells.

As part of the detailed design for Fermi 3, the present groundwater monitoring programs will be evaluated with respect to the addition of Fermi 3 to determine if any modification of the existing programs is required to adequately monitor plant effects on the groundwater. As mentioned previously, several wells exist onsite from previous projects and investigations. It may be possible to integrate some of these wells into future monitoring activities. Any revised integrated monitoring plan will adhere to the guidance outlined in "Integrated Ground-Water Monitoring Strategy for NRC-Licensed Facilities and Sites: Logic, Strategic Approach and Discussion"

Attachment 5
NRC3-10-0046

Response to RAI Letter No. 42
(eRAI Tracking No. 4882)

RAI Question No. 12.03-12.04-7

NRC RAI 12.03-12.04-7

Fermi 3 Revision 2 COL FSAR Section 12.3 provides revised DCD tables and figures affected by the Departure EF3 DEP 11.4-1, "Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste." In Part 7, "Departure Report," of the COL application, the applicant states that Fermi 3 Radwaste Building waste storage space has been configured to accommodate at least ten years of Class B and C waste generated during plant operation. Shielding analyses show the resultant dose rates in surrounding areas, both within the building and externally, are maintained within the applicable range for the corresponding radiological area classification specified in FSAR Subsection 12.3.1.3. There is, however, no discussion of this departure in FSAR Section 12.3.

1. *Provide a discussion of this departure in FSAR Section 12.3 and include a discussion in the FSAR of the table (Table 12.3-8) and figures (Figures 12.3) added to chapter 12 of the FSAR. A comparison of the revised FSAR tables and figures with those in DCD Revision 6 reveals numerous changes in room layout and dimensions, with some rooms/walls located above the grade level in the FSAR, where as in the DCD they are shown as being below grade. In addition, the layout changes have resulted in changes in access and egress routes within this building. These changes could impact the dose rates calculated in the DCD. In order for the staff to make a determination of reasonable assurance that the dose rates are maintained below the allowable limits, the applicant needs to:*

2. *Verify that the source terms used for the components in the radwaste building are the same as those provided in DCD Revision 6. If these source terms are different than those provided in the DCD, then provide justification for these changes and verify that your shielding analysis to determine the area dose rates incorporates these revised source term values.*

3. *Provide analyses and descriptions of the effects of the geometry and layout changes (made for the Fermi radwaste building) on the various radwaste building dose rates calculated in the DCD.*

4. *Describe the basis for any differences between the equipment dimensions for the various pieces of equipment located in the various rooms in the radwaste building at Fermi and the comparable values described in Table 12.2-22 of the DCD.*

5. *Describe any differences in shield wall thickness between those values listed in FSAR Table 12.3-8R and in the comparable Table 12.3-8 in the ESBWR DCD. Provide the basis for any differences.*

Response

This RAI response is based on DCD Revision 7 and anticipated changes in DCD Revision 8. The numerical responses below correspond to the requests in the RAI.

1. For clarity, the following discussion to address Departure EF3 DEP 11.4-1, "Long-term, Temporary Storage of Class B and C Low-Level Radioactive Waste," will be added to FSAR Section 12.3.

   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
   - Figures 12.3-19R through 12.3-22R replace DCD Figures 12.3-19 through 12.3-22
   - Figures 12.3-39R through 12.3-42R replace DCD Figures 12.3-39 through 12.3-42
   - Figures 12.3-61R through 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.

   During development of this RAI response, additional changes were also identified for FSAR Sections 1.2 and 11.4 to clearly identify which Tables and/or Figures are replaced by the departure.

2. The source terms used for the components in the departure are the same as those used in the DCD. As such, no further shielding analysis was required.

3. As described in the response to question 2, re-analysis of the shielding was not required; however, a qualitative evaluation of each wall in the Radwaste Building was performed. The evaluation consisted of comparing the thickness and function (i.e. what the wall separates) 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. If necessary the departure wall thickness was revised. In this manner, the radiation zones in the departure were maintained the same as those in the DCD. An update to FSAR Table 12.3-8R is included as part of the attached markups. Shielding thicknesses for the other buildings identified in Table 12.3-8R were updated to be consistent with DCD Revision 7 and anticipated changes in DCD Revision 8.

4. Equipment dimensions in the departure are the same as those used in the DCD. As such, the source geometry, source characteristics and quantities, as shown in DCD Table 12.2-22 are unchanged in the departure. During this evaluation it was noted that some of the room numbers of DCD Table 12.2-22 have been changed by the departure. A revised Table 12.2-22R is attached, reflecting those room number changes.

5. The matrix in Table 1 below provides a comparison of DCD wall thicknesses (based on DCD Revision 7 and anticipated changes in DCD Revision 8) to the wall thicknesses in FSAR Table 12.3-8R.

Table 1- EVALUATION OF REVISED WALL THICKNESSES

NOTES:
(1) All dimensions in centimeters.
(2) Assume pump rooms and valve galleries are similar areas.
(3) Assume the control room, corridors and the electrical equipment rooms are similar areas.
(4) DCD wall thicknesses are taken from DCD, Revision 8, Table 12.3-8. Departure wall thicknesses are shown in FSAR Table 12.3-8R.
(5) The ceiling thickness for Rooms 6104, 6105, 6150 and 6160 are the same as Room 6103.

ROOM 6103 – EQUIPMENT DRAIN COLLECTION TANK ROOM A										
Dimension & Function Source	**North Wall Thickness**	**North Wall Function**	**East Wall Thickness**	**East Wall Function**	**South Wall Thickness**	**South Wall Function**	**West Wall Thickness**	**West Wall Function**	**Floor**	**Ceiling**
DCD	70	Separates tank room from sump room	60	Separates tank room from tank room	60	Separates tank room from tank/pump room	60	Separates tank room from tank room	Ground	80
DEPARTURE	120 (External Below Grade)	Separates tank room from ground	90	Separates tank room from electrical equipment room	80	Separates tank room from pump rooms	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Shielding no longer necessary. No further evaluation required.		Walls in the DCD separating tank rooms from corridors are between 70 and 100 cms. (See Note 3.) Assume similar function and increased thickness. No further evaluation required.		Similar functions and thicker wall. No further evaluation required.		Same function and thickness. No further evaluation required.			
ROOM 6104 EQUIPMENT DRAIN COLLECTION TANK ROOM B										
DCD	70	Separates tank room from pump room	60	Separates tank room from tank room	60	Separates tank room from tank room	80	Separates tank room from corridor	Ground	80
DEPARTURE	120 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	80	Separates tank room from pump room	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Shielding no longer necessary. No further evaluation required.		Same function and thickness. No further evaluation required.		Similar walls in the DCD (separating tank rooms from pump rooms) are 70 cm. This thickness is greater. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.			See Note 5
ROOM 6105 EQUIPMENT DRAIN COLLECTION TANK ROOM C										
DCD	60	Separates tank room from tank room	60	Separates tank room from tank/pump room	80	Separates tank room from corridor	80	Separates tank room from corridor	Ground	80
DEPARTURE	120 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	80	Separates tank room from pump room	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Shielding no longer necessary. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.		Similar walls in the DCD (separating tank rooms from pump rooms) are 70 cm. This thickness is greater. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.			See Note 5

Dimension & Function Source	North Wall Thickness	North Wall Function	East Wall Thickness	East Wall Function	South Wall Thickness	South Wall Function	West Wall Thickness	West Wall Function	Floor	Ceiling
ROOM 6106 LOW ACTIVITY RESIN HOLDUP TANK ROOM (NOTE: IN DCD THIS IS ROOM 6107)										
DCD	100 (External Below Grade)	Separates tank room from ground	80	Separates tank room from pump room	60	Separates tank room from pump room	100 (External Below Grade)	Separates tank room from ground	Ground	80
DEPARTURE	60	Separates tank room from valve gallery	60	Separates tank room from tank room	130 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Similar walls in the DCD (separating tank rooms from pump or valve rooms, see Note 2) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.		Shielding no longer necessary. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.			
ROOM 6107 CONDENSATE RESIN HOLDUP TANK ROOM (NOTE: IN DCD THIS IS ROOM 6106)										
DCD	90 (External Below Grade)	Separates tank room from ground	40	Separates tank room from tank room	80	Separates tank room from corridor	60	Separates tank room from pump room	Ground	80
DEPARTURE	60	Separates tank room from valve gallery	90	Separates tank room from corridor	130 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Similar walls in the DCD (separating tank rooms from pump or valve rooms, see Note 2) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. Assume similar function and increased thickness. No further evaluation required.		Shielding no longer necessary. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.			
ROOM 6108 HIGH ACTIVITY RESIN HOLDUP TANK ROOM										
DCD	80	Separates tank room from pump room	100	Separates tank room from corridor	80	Separates tank room from pump room	100 (External Below Grade)	Separates tank room from ground	Ground	80
DEPARTURE	110	Separates tank room from valve gallery and corridor	100	Separate tank room from electrical equipment room	130	Separates tank room from corridor	110	Separates tank room from corridor	Ground	91
CONCLUSIONS	Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. Assume similar function and increased thickness. No further evaluation required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. Assume similar function and same thickness. No further evaluation required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. Assume similar function and increased thickness. No further evaluation required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. Assume similar function and increased thickness. No further evaluation required.			

ROOM 6109 CONCENTRATED WASTE TANK ROOM

Dimension & Function Source	North Wall Thickness	North Wall Function	East Wall Thickness	East Wall Function	South Wall Thickness	South Wall Function	West Wall Thickness	West Wall Function	Floor	Ceiling
DCD	70	Separates tank room from pump room	90	Separates tank room from corridor	90	Separates tank room from corridor	100 (External Below Grade)	Separates tank room from ground	Ground	80
DEPARTURE	60	Separates tank room from valve gallery	60	Separates tank room from tank room	130 (External Below Grade)	Separates tank room from ground	90	Separates tank room from corridor	Ground	91
CONCLUSIONS	Similar walls in the DCD (separating tank rooms from pump or valve rooms) are 60 cm. The thickness is the same as that used in the DCD for separating similar rooms. As such, no further evaluation is required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is consistent with the DCD. No further evaluation required.		Shielding no longer necessary. No further evaluation required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. This is the same function and thickness. No further evaluation required.			
ROOM 6150 FLOOR DRAIN COLLECTION TANK ROOM A										
DCD	70	Separates tank room from pump room	80	Separates tank room from corridor	60	Separates tank room from tank room	60	Separates tank room from tank room	Ground	80
DEPARTURE	120 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	80	Separates tank room from pump room	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Shielding no longer necessary. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is consistent with the DCD. No further evaluation required.		Similar walls in the DCD (separating tank room from pump room) are 70 cm. This wall is thicker. No further evaluation is required.		Same function and thickness. No further evaluation required.			See Note 5
ROOM 6160 FLOOR DRAIN COLLECTION TANK ROOM B										
DCD	60	Separates tank room from tank room	80	Separates tank room from corridor	80	Separates tank room from corridor	60	Separates tank room from tank/pump room	Ground	80
DEPARTURE	120 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	80	Separates tank room from pump room	60	Separates tank room from pump room	Ground	91
CONCLUSIONS	Shielding no longer necessary. No further evaluation required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is consistent with the DCD. No further evaluation required.		Similar walls in the DCD (separating tank room from tank/pump rooms) are 60 cm. This wall is thicker. No further evaluation is required.		Similar walls in the DCD (separating tank room from tank/pump rooms) are 60 cm. This wall is the same as that used in the DCD for similar rooms. As such, no further evaluation is required.			See Note 5

ROOM 6161 LOW ACTIVITY PHASE SEPARATOR ROOM

DCD	100 (External Below Grade)	Separates tank room from ground	70	Separates tank room from pump room	100	Separates tank room from corridor	60	Separates tank room from tank room	Ground	80
DEPARTURE	60	Separates tank room from valve gallery	70	Separates tank room from tank room	130 (External Below Grade)	Separates tank room from ground	60	Separates tank room from tank room	Ground	91
CONCLUSIONS	Similar walls in the DCD (separating tank rooms from pump or valve rooms, see Note 2) are 60 cm. The thickness is the same as that used in the DCD for similar rooms. As such, no further evaluation is required.		Similar walls in the DCD (separating tank rooms) are 60 cm. The thickness is consistent with the DCD and exceeds the DCD thickness for this function. No further evaluation required.		Shielding no longer necessary. No further evaluation required.		Same function and thickness. No further evaluation required.			

ROOM 6171 FLOOR & EQUIPMENT DRAIN SAMPLE TANK ROOM

Dimension & Function Source	North Wall Thickness	North Wall Function	East Wall Thickness	East Wall Function	South Wall Thickness	South Wall Function	West Wall Thickness	West Wall Function	Floor	Ceiling
DCD	30 (External Below Grade)	Separates tank room from ground	35	Separates tank room from electrical equipment room	30	Separates tank room from corridor	30	Separates tank room from pump rooms and corridor	Ground	80
DEPARTURE	120 (External Below Grade)	Separates tank room from ground	60	Separates tank room from pump room	60	Separates tank room from corridor	120 (External Below Grade)	Separates tank room from ground	Ground	91
CONCLUSIONS	Shielding no longer necessary. No further evaluation required.		Wall thickness greater than that shown in the DCD. No further evaluation required.		Wall thickness greater than that shown in the DCD. No further evaluation required.		Shielding no longer necessary. No further evaluation required.			
ROOM 6251 HIGH ACTIVITY PHASE SEPARATOR ROOM (NOTE: IN THE DCD THIS IS ROOM 6151)										
DCD	100 (External Below Grade)	Separates tank room from ground	90	Separates tank room from pump room	100	Separates tank room from corridor	70	Separates tank room from pump room	Ground	80
DEPARTURE	90	Separates tank room from corridor	90	Separates tank room from Radwaste Control Room	90	Separates tank room from pump room & valve gallery	90	Separates tank room from corridor	90	91
CONCLUSIONS	Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. This is the same function and thickness. No further evaluation required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. This is a similar function and the thickness. No further evaluation required.		Typically, walls in the DCD separating tank rooms from pump/valve rooms are between 60 and 90 cm. This wall is the same function and thickness as the east wall of this room in the DCD. No further evaluation required.		Typically, walls in the DCD separating tank rooms from corridors are between 70 and 100 cm. See Note 3. This is the same function and thickness. No further evaluation required.			

Proposed COLA Revision

Attached are proposed markups for the FSAR to address the changes discussed above. Changes were incorporated throughout the departure package to clarify appropriate incorporation of departure tables and figures.

Markup of Detroit Edison COLA
(following 14 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA Part 2 FSAR. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

1.2.2.12.15 Zinc Injection System

Replace this section with the following.

STD CDI

The Zinc Injection System is not utilized.

1.2.2.12.16 Freeze Protection

Replace this section with the following.

STD CDI

Freeze protection is incorporated at the individual system level using insulation and heat tracing for all external tanks and piping that may freeze during winter weather.

Insert 1 Here.

1.2.2.16.10 Other Building Structures

Replace the fifth paragraph with the following.

EF3 CDI

Other facilities include the Service Building, Water Treatment Building, Administration Building, Training Center, Sewage Discharge System, warehouse, and hot and cold machine shop. These are all of conventional size and design, and in some cases may be shared with other units at the same site.

STD SUP 1.2-1

1.2.2.19 Modular Construction Techniques and Plans

[START COM 1.2-001] To the extent practical, modular construction techniques that have been applied during ABWR construction projects will be adapted and/or modified for use during ESBWR construction. Modularization reviews will be performed to develop a plan for bringing the ABWR experience into the ESBWR. Once completed, the results of the modularization reviews will be used as guidance to develop the detailed design of the areas affected by modularization.**[END COM 1.2-001]**

Insert 1

	1.2.2.16.9 **Radwaste Building**
EF3 DEP 11.4-1	Replace Figures 1.2-21 to 1.2-25 with Figures 1.2-21R to 1.2-25R in the parenthesis in the first sentence.

11.4 Solid Waste Management System

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

Replace the third and fourth sentences of the third paragraph with the following.

DCD

EF3 DEP 11.4-1

The SWMS component capacities are provided in Table 11.4-1R. The estimated annual waste generated from the SWMS Subsystem is provided in Table 11.4-2R. Table 11.4-2R also identifies Class A, B, and C waste in accordance with 10 CFR 61.55 (Reference 11.4-16) and the quantities of waste that would be shipped or stored in the long-term storage area of the Radwaste Building if a licensed disposal facility is not available.

Replace text references to DCD Table 11.4-1, Table 11.4-2, Figure 11.4-1, and Figure 11.4-2 with Table 11.4-1R, 11.4-2R, Figure 11.4-1R, and Figure 11.4-2R, respectively.

11.4.1 SWMS Design Bases

Replace the seventh bullet of the first paragraph with the following.

EF3 DEP 11.4-1
STD COL 11.4-4-A

- The Radwaste Building has been configured to accommodate at least 10 years of packaged Class B and C waste and approximately three months of packaged Class A waste, considering routine operations and anticipated operational occurrences. This Class B and C waste storage capacity is based on a conservative estimate of the annual generation of low-level waste, without credit for potential waste minimization techniques and methods other than dewatering. In order to further minimize waste volume a more restrictive waste minimization plan is implemented. This plan will consider strategies to reduce generation of Class B and C waste, including reducing the in-service run length of resin beds, as well as resin selection, short-loading, and point of generation segregation techniques. Implementation of these techniques could substantially extend the capacity of the Class B and C storage area in the Radwaste Building.

Add the following after the second paragraph.

STD SUP 11.4-1

The LWMS offsite dose calculations, which are described in Subsection 12.2.2.4, include the offsite doses from the SWMS liquid

STD COL 12.1-1-A This COL item is addressed in Subsection 12.1.1.3.2 and Appendix 12BB.

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 and Appendix 12BB.

12.1-3-A **Operational Considerations**

STD COL 12.1-3-A This COL item is addressed in Subsection 12.1.3 and Appendix 12BB.

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 and Appendix 12BB.

12.2 Plant Sources

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

Insert 1 Here.

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.

Insert 1

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

Table 12.2-22R Radiation Source Parameters (Sheet 1 of 2) [EF3 DEP 11.4-1]

Component	Room	Assumed Shielding Source						
		Source Approx Geometry Rt. Cylinder (r, l)		Source Characteristics				Quantity
		Length (m)	Radius (m)	Type	Material	Density (g/cm^3)	Equipment Self-Shielding	
RWCU/SDC (RB)								
Non regenerative Heat Exchanger Tube side	1151/1250 1161/1260	7.00	0.16	Homogeneous	Water	0.967	Steel 2cm thick	Three
Regenerative Heat Exchanger Tube side Shell side	1151/1250 1161/1260	7.00 7.00	0.16 0.25	Homogeneous Homogeneous	Water Water	0.836 0.990	Steel 2cm thick	Two
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	10.45m^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
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 Shell Well	4186	1284 m^3 2136 m^3		Homogeneous Homogeneous	Water Water	7.21E-04 1	Steel 1cm thick Steel 1cm thick	Three (Bodies)
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	~~6184~~ 6282	15 m^3		Homogeneous	Water	1	Steel 1cm thick	Two

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

Component	Room	Assumed Shielding Source						
		Source Approx Geometry Rt. Cylinder (r, l)		Source Characteristics				Quantity
		Length (m)	Radius (m)	Type	Material	Density (g/cm^3)	Equipment Self-Shielding	
Equipment Drain Sample Tank	~~6172~~ 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
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	~~6107~~ 6106	0.48	2.00	Homogeneous	Water	0.69	Steel 1cm thick	One
High/Low Activity Phase Separator Room	~~6151/6161~~ 6251/6161	0.48	2.00	Homogeneous	Water	1.00	Steel 1cm thick	Two
Condensate Resin Holdup Tank	~~6106~~ 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

12.3 Radiation Protection

Insert 1 Here.

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

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.

12.3.1.5.2 Operational/Programmatic Considerations

Replace this section with the following.

STD COL 12.3-4-A

Operational programs and procedures that address the requirements of 10 CFR 20.1406 are necessary adjuncts to the design features. The operational and post-construction objectives in Regulatory Guide 4.21 Positions C.1 through C.4 are addressed as follows:

- 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

Insert 1

EF3 DEP 11.4-1

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
- Figures 12.3-19R through 12.3-22R replace DCD Figures 12.3-19 through 12.3-22
- Figures 12.3-39R through 12.3-42R replace DCD Figures 12.3-39 through 12.3-42
- Figures 12.3-61R through 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.

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

Replace with new Table 12.3-8R Attached.

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	90 (35)
-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)	110 (43)	Ground	90 (35)
-11500	2150	FAPC Pump/Heat Exchanger Room A	35 (14)	70 (28)	60 (24)	30 (12)	Ground	70 (28)
-11500	2151	Backwash Transfer Pump Room A	90 (35)	105 (41)	70 (28)	95 (37)	Ground	70 (28)
-11500	2160	FAPC Pump/Heat Exchanger Room B	35 (14)	30 (12)	60 (24)	35 (14)	Ground	70 (28)
-11500	2161	Backwash Transfer Pump Room B	70 (28)	105 (41)	70 (28)	95 (37)	Ground	70 (28)
-6400	1250	RWCU/SDC Heat Exchanger Room A	[illegible]	110 (43)	100 (39)	100 (39)	70 (28)	70 (28)
-6400	1251	RWCU/SDC Filter/Demineralizer Vault A1	[illegible]	150 (59)	40 (16)	135 (53)	110 (43)	90 (35)
-6400	1252	RWCU/SDC Filter/Demineralizer Vault A2	[illegible]	150 (59)	40 (16)	135 (53)	110 (43)	90 (35)
-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)	40 (16)	150 (59)	40 (16)	110 (43)	90 (35)
-6400	1262	RWCU/SDC Filter/Demineralizer Vault B2	135(53)	40 (16)	150 (59)	70 (28)	110 (43)	90 (35)
-6400	2251	FAPC Filter/Demineralizer Vault 1	90 (35)	70 (28)	30 (12)	90 (35)	70 (28)	70 (28)
-6400	2261	FAPC Filter/Demineralizer Vault 2	30 (12)	70 (28)	115 (45)	90 (35)	70 (28)	70 (28)
		Radwaste Building	cm (in)					
-9350	6103	Equipment Drain Collection Tank Room A	120 (47)	90 (35)	80 (31)	60 (24)	Ground	91 (36)
-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)	100 (39) 110 (43)	Ground	91 (36)

Table 12.3-8R Shielding Geometry (Nominal) [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)

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

Elev.	Room	Room Name	North	East	South	West	Floor	Ceiling
-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)
-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)

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

Elev.	Room	Room Name	North	East	South	West	Floor	Ceiling
Radwaste Building (continued)			**cm (in)**					
-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	90 (35)	90 (35)	90 (35)	90 (35)	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			**cm (in)**					
-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)
-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) [EF3 DEP 11.4-1]

Elev.	Room	Room Name	North	East	South	West	Floor	Ceiling
Turbine Building (continued)			**cm (in)**					
-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 5Aand 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)

Markup of Detroit Edison COLA
(following 2 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in a future submittal of the Fermi 3 COLA Part 7 Departures Report. However, the same COLA content may be impacted by revisions to the ESBWR DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be different than presented here.

DTE Energy®

Detroit Edison

Fermi 3 Combined License Application

Part 7: Departures Report

(Includes Information on Departures, Exemptions and Supplemental Information)

Revision 2
March 2010

Introduction:

A departure is a plant-specific deviation from design information in a standard design certification rule. Departures from the reference ESBWR Design Control Document (DCD) are identified and evaluated consistent with regulatory requirements and guidance. Each departure is examined in accordance with 10 CFR 52 requirements. Although the ESBWR Design Certification Application is currently under review with the NRC, departures are evaluated utilizing the guidance provided in Regulatory Guide 1.206, Section C.IV.3.3.

The following departure is evaluated in this report:

EF3 DEP 11.4-1: Long-term, Temporary Storage of Class B and C Low-Level Radioactive Waste

Departure: EF3 DEP 11.4-1 - Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

Summary of Departure:

The ESBWR DCD identifies that on-site storage space for a six-month volume of packaged waste is provided in the Radwaste Building. The Fermi Unit 3 Radwaste Building is configured to accommodate a minimum of ten years volume of packaged Class B and C waste, while maintaining space for at least three months of packaged Class A waste. This departure is effected by reconfiguring the arrangement of systems and components within the ESBWR RWB volume. The systems structures and components requiring re-arrangement are associated with the Liquid Waste Management System (LWMS) and Solid Waste Management System (SWMS). The existing Radwaste Building Fire Protection and HVAC Systems have sufficient capacity to accommodate the extra volume of Class B and C wastes, and require no modification.

Scope/Extent of Departure:

This departure affects Tier 1 information in the ESBWR DCD. This departure is identified in Part 10: ITAAC Section 1. 1.2.2.16.9, 12.2, and 12.3

This departure affects Tier 2 information in the ESBWR DCD. This departure is identified in FSAR Sections 1.2.2.10.2, 9.4.3.1, 11.4, 11.4.1, 11.4.2.2.1, 11.4.2.2.2, 11.4.2.2.4, ~~and~~ 11.4.2.3.1; FSAR Tables 9A.5-5R, 11.4-1R, 11.4-2R, 12.3-4R, and 12.3-8R; and FSAR Figures 1.2-21R, 1.2-22R, 1.2-23R, 1.2-24R, 1.2-25R, 9A.2-20R, 9A.2-21R, 9A.2-22R, 9A.2-23R, 9A.2-24R, 11.4-1R, 11.4-2R, 12.3-19R, 12.3-20R, 12.3-21R, 12.3-22R, 12.3-39R, 12.3-40R, 12.3-41R, 12.3-42R, 12.3-61R, 12.3-62R, 12.3-63R, and 12.3-64R.

12.2-22R,

Departure Justification:

DCD Sections 11.4.1, SWMS Design Basis, and 11.4.2.2.4, Container Storage Subsystem, discuss on-site storage space for low-level radioactive waste. The design accommodates a sixmonth volume of packaged waste storage in the Radwaste Building.