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

10 CFR 51.45
10 FCR 52.77
10 CFR 52.79

May 7, 2010
NRC3-10-0018

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

References: 1) Fermi 3
Docket No. 52-033
2) Letter from Ilka T. Berrios (USNRC) to Jack M. Davis (Detroit Edison), "Request for Additional Information Letter No. 28 Related to the SRP Sections 2.4 and 3.7 for the Fermi 3 Combined License Application," dated March 26, 2010

Subject: Detroit Edison Company Response to NRC Request for Additional Information Letter No. 28

In Reference 2, the NRC requested additional information (RAI) to support the review of certain portions of the Fermi 3 Combined License Application (COLA). The responses to these RAIs are provided in Attachments 1 through 5 of this letter. Information contained in these responses will be incorporated into a future COLA submission as described in the RAI response.

The response to RAI 02.04.13-10 contains electronic files provided on CD as a separate enclosure.

The file format and names on the enclosed CD do not comply with the requirements for electronic submission in the NRC Guidance Document, "Guidance for Electronic Submissions to the NRC," dated June 25, 2009; the files are not "pdf" formatted. The NRC Staff requested the files be submitted in their native formats required by the software in which they are utilized to support NRC review of the COLA.

D095
NRO

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

I state under penalty of perjury that the foregoing is true and correct. Executed on the 7th day of May 2010.

Sincerely,

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

Attachments:
1) Response to RAI Letter No. 28 (Question Nos. 03.07.02-2; 03.07.02-3; 03.07.02-4)
2) Response to RAI Letter No. 28 (Question No. 02.04.02-5)
3) Response to RAI Letter No. 28 (Question No. 02.04.05-9)
4) Response to RAI Letter No. 28 (Question No. 02.04.05-10)
5) Response to RAI Letter No. 28 (Question No. 02.04.13-10)

cc: Ilka Berrios, NRC Fermi 3 Project Manager
Chandu Patel, NRC Fermi 3 Project Manager (w/o Enclosure CD)
Jerry Hale, NRC Fermi 3 Project Manager (w/o Enclosure CD)
Bruce Olson, NRC Fermi 3 Environmental Project Manager (w/o Enclosure CD)
Fermi 2 Resident Inspector (w/o Enclosure CD)
NRC Region III Regional Administrator (w/o Enclosure CD)
NRC Region II Regional Administrator (w/o Enclosure CD)
Supervisor, Electric Operators, Michigan Public Service Commission (w/o Enclosure CD)
Michigan Department of Environmental Quality
Radiological Protection and Medical Waste Section (w/o Enclosure CD)

Attachment 1
NRC3-10-0018

Response to RAI Letter No. 28
(eRAI Tracking No. 4496)

RAI Question No. 03.07.02-2
RAI Question No. 03.07.02-3
RAI Question No. 03.07.02-4

NRC RAI 03.07.02-2

In accordance with 10 CFR Part 50, General Design Criteria (GDC) 2, SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The applicant provided some information on the physical dimensions, configuration, and location of the various safety-related and non-safety-related buildings on the Fermi site in FSAR Rev. 0, Section 02.03, Figure 2.3-261, "Onsite Release Points and Intake Locations." In Rev. 1 of the FSAR, this figure was deleted.

In order for the staff to conclude that all SSCs important to safety will be designed to withstand the effects of natural phenomena without the loss of capability to perform their safety functions in accordance with GDC 2, the staff needs additional information. The staff requests that the applicant provide a plan view of all of the structures on the site along with the building dimensions and heights and the structures' seismic category for the Fermi site. The applicant is also requested to include these details for all the structures associated with the PSWS and SWS. The staff needs this information to confirm that the seismic Category I structures are protected from failure of non-seismic category I structures as a result of seismic events.

Additionally, please clarify the following confusing statement from the response to RAI letter No. 7, Tracking No. 2785, Question No. 03.07.02-1, "The Natural Draft Cooling Tower (NDCT) has a height of 600 feet, and is the tallest structure on the FERMI site. Any structure that is more than 600 feet from any seismic category I structure is acceptable and therefore not listed on the attached table. Only structures that are within 600 feet of Category I structure are listed, with the exception of the NDCT." Also, explain why the NDCT natural draft cooling tower is not listed in the table of RAI response letter No. 7, eRAI Tracking No.2785, and why the NPHS cooling tower is not listed in site plan in Figure 2.1-4, Revision 1.

NRC RAI 03.07.02-3

In accordance with 10 CFR Part 50, General Design Criteria (GDC) 2, SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. Section 2.4.2, "ITAAC FOR PLANT SERVICE WATER SYSTEM (PORTION OUTSIDE THE SCOPE OF THE CERTIFIED DESIGN)" of Part 10 states that, "The Plant Service Water System (PSWS) is the heat sink for the Reactor Component Cooling Water System. The PSWS does not perform any safety-related function. There is no interface with any safety-related component." The physical dimensions, configuration, and location of the PSWS structures were not discussed in Section 3.7.2 of the FSAR. Additionally, the interactions of PSWS structures with seismic category I structures were also not addressed by the applicant. Therefore, the staff requests that the applicant describe and confirm that postulated failures of the PSWS will not lead to adverse II/I interactions with any adjacent safety related SSCs. The staff needs this information to conclude that all SSCs important to safety will be designed to withstand the effects of natural phenomena without the loss of capability to perform their safety functions in accordance with GDC 2.

NRC RAI 03.07.02-4

In accordance with 10 CFR Part 50, General Design Criteria (GDC) 2, SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. Section 2.4.3, "STATION WATER SYSTEM (SWS)" of Part 10 indicates that the SWS includes plant intake structures. The physical dimensions, configuration, and location of the SWS structures were not discussed in Section 3.7.2 of the FSAR. Additionally, the interactions of SWS structures with seismic category I structures were also not addressed by the applicant. The staff requests that the applicant describe and confirm that postulated failures of the SWS will not lead to adverse II/I interactions with any adjacent safety related SSCs. The staff needs this information to conclude that all SSCs important to safety will be designed to withstand the effects of natural phenomena without the loss of capability to perform their safety functions in accordance with GDC 2.

Response

The responses to NRC RAIs 03.07.02-2, 03.07.02-3, and 03.07.02-4 are provided in the following combined response. The single combined response is provided as the RAIs are focused on the topic of adverse II/I interactions of non-Category I structures with adjacent seismic Category I structures.

FSAR Revision 0 incorporated ESBWR DCD Revision 4 by reference. ESBWR DCD Revision 4 did not include a figure showing the onsite release points and source receptor locations used in the ARCON96 analysis. Thus, FSAR Revision 0 included Figure 2.3-261 to show the onsite release points and source receptor locations used in the ARCON96 analysis (FSAR Section 2.3.4.3). FSAR Revision 1 incorporated ESBWR DCD Revision 5 by reference. ESBWR DCD Revision 5, Appendix 2A, Figure 2A-1, provides a figure for onsite source receptor pairs. Thus, FSAR Figure 2.3-261 was no longer needed and was removed from the FSAR as part of Revision 1.

DCD Section 3.7.2.8 addresses the interaction of non-Category I structures with seismic Category I structures and establishes design criteria that protect seismic Category I structures from the failure of non-Category I structures. FSAR Section 3.7.2.8 incorporates DCD Section 3.7.2.8 by reference and includes a supplemental statement indicating that the locations of the structures are provided in FSAR Figure 2.1-204. FSAR Figure 2.1-204 provides a scaled plan view of all structures on site.

DCD Section 3.7.2.8 requirements are satisfied if all site-specific, non-Category I structures are separated from Seismic Category I structures by a distance equal to or greater than their height above grade.

On the Fermi 3 site, the tallest structure is the 600 ft Natural Draft Cooling Tower (NDCT) /Normal Power Heat Sink (NPHS) (see FSAR Table 10.4-3R and FSAR Section 10.4.5.8).

FSAR Section 10.4.5.8 states:

> *"The NDCT is located at least a distance equal to its height away from any seismic Category 1 or 2 structures. Thus, if there were any structural failure of the cooling tower, no seismic Category 1 or 2 structures or any safety-related systems or components would be affected or damaged."*

Thus, the NDCT is located at least 600 ft from the closest seismic Category I structure. Being the tallest structure on the Fermi 3 site at 600 ft, any structure that is located at least 600 ft from the closest Category I structure would meet requirement 1 from DCD Section 3.7.2.8. That is, any such structure would be shorter than 600 ft and located greater than 600 ft from a seismic Category I structure.

As shown on FSAR Figure 2.1-204, there are five non-Category I structures (other than those addressed in the DCD) that are less than 600 ft from the closest seismic Category I structure. Table 1 below shows the enveloping height above grade for these five structures plus the NDCT/NPHS Cooling Tower and the distance to the closest Category I structure. This information in Table 1 was previously included in the response to NRC RAI 03.07.02-1 in Detroit Edison letter NRC3-09-0021, dated August 25, 2009. The site plan shown in FSAR Revision 2, Figure 2.1-204 shows the NDCT/NPHS cooling tower as item 23. The Plant Service Water System (PSWS) Tower is labeled as the "Service Water Cooling Tower" and is item 16 on FSAR Revision 2, Figure 2.1-204. The Station Water System structure is the "Station Water Intake" and is item 26 on FSAR Revision 2, Figure 2.1-204. The Station Water Intake is approximately 1,000 ft from the closest seismic Category I structure and is much less than 600 ft tall; therefore it is not included in Table 1 below.

Table 1

Plant-Specific Structure (Figure 2.1-204 ID No.)	Height Above Grade (feet)	Closest Seismic Category I Structure	Distance to Closest Seismic Category I Structure (feet)
Diesel Fuel Oil Storage Tank (13)	< 50	Fire Water Tank & Pumps	> 60
Water Treatment/Service Water Building (14)	< 80	Fire Water Tank & Pumps	> 80
Service Water Cooling Tower (16) (PSWS Tower)	< 100	Fire Water Tank & Pumps	> 100
Water Storage Tanks (18)	< 50	Fuel Building	> 100
NDCT/NPHS Cooling Tower (23)	600	Fuel Building	> 700
PAP/VIB (40)	< 150	Reactor Building	> 550

Table 1 shows a conclusion gleaned from FSAR Figure 2.1-204 that the height of each plant-specific identified structure is less than the distance to the closest seismic Category I structure. The information contained in this table may change as the detailed design is completed. Any changes however will continue to meet the DCD criteria to protect seismic Category I structures from the failure of non-Category I structures.

Proposed COLA Revision

A proposed markup to FSAR Section 3.7.2.8 is attached.

Markup of Detroit Edison COLA
(following 2 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in the next submittal of the Fermi 3 COLA Revision 3. 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.

EF3 SUP 3.7-1

3.7.1.1.4 Site-Specific Design Ground Motion Response Spectra

The site-specific design Ground Motion Response Spectra (GMRS) and the FIRS are described in Subsection 2.5.2. The CSDRS are compared with the FIRS in Table 2.0-201.

EF3 SUP 3.7-2

3.7.1.1.5 Site-Specific Design Ground Motion Time History

As shown in Table 2.0-201, the CSDRS fully envelope the site specific FIRS, and the Fermi 3 site parameters meet the requirements of the DCD for foundation bearing capacities,minimum shear wave velocity, and liquefaction potential. Therefore, site-specific earthquake ground motion time history is not developed to match the GMRS/FIRS.

3.7.1.3 Supporting Media for Seismic Category I Structures

Add the following at the end of the first paragraph.

EF3 SUP 3.7-3

Subsection 2.5.4 provides site-specific properties of subsurface materials.

3.7.2.4 Soil-Structure Interaction

Add the following at the end of the first paragraph.

EF3 SUP 3.7-4

Subsection 2.5.4 describes the site-specific properties of subsurface materials.

3.7.2.8 Interaction of Non-Category I Structures with Seismic Category I Structures

Add the following at the end of this section.

Add Insert "1" here.

EF3 SUP 3.7-5

The locations of structures are provided in Figure 2.1-204.

3.7.4 Seismic Instrumentation

Add the following at the end of this section.

Insert "1"

Non-Category I structures within the scope of the DCD are addressed in the DCD. Non-Category I structures outside the scope of the DCD are located at least a distance of its height above grade from Seismic Category I structures. Thus, the collapse of any site specific non-Category I structure, system, or component will not cause the non-Category I structure, system, or component to strike a Seismic Category I structure, system, or component.

Attachment 2
NRC3-10-0018

Response to RAI Letter No. 28
(eRAI Tracking No. 4501)

RAI Question No. 02.04.02-5

NRC RAI 02.04.02-5

To meet the requirements of 100.20(c) and 52.79(a)(1)(iii) and to support the staff's review of the application, the staff requests additional information concerning the erosion protection measures to be used for the slopes of the Fermi 3 elevated area. The staff requests that the applicant evaluate the erosive forces on the slopes of the Fermi 3 elevated area caused by potential wave run-up resulting from the flooding alternatives. The applicant should discuss the characteristics of erosion protection measures on the slopes and how these will be constructed to resist erosive forces from the wave run-up.

Response

As discussed in response to RAI 02.04.02-4 in Detroit Edison Letter NRC3-10-0007, dated January 29, 2010 (ML100330612), the maximum allowable run-off velocity to avoid erosion for the type of soil at the site (graded loam to gravel), is five feet per second. Two potential erosion protection measures were discussed as a means of achieving this velocity (grass surfacing and rip rap). Grass surfacing of the area would reduce the velocity to 4.47 feet per second. As discussed in the response to RAI 02.04.02-4, the maximum permissible velocity for grass surfacing established by sod is between five and six feet per second. If rip rap were used as a control measure, a D50 of 0.25 feet would be required.

During a postulated surge and seiche event, the slopes of the elevated area that face Lake Erie would be subject to wave run-up, which in turn could result in erosion. FSAR Figure 2.4-217 shows the Fermi 3 elevated area. The effectiveness of preventing erosion from wave run-up for the protection measures discussed in the response to RAI 02.04.02-4 is discussed below.

For the case of the 100-year lake levels with 100 mph winds, the onshore area would be flooded by 3.6 feet of water. This area between the top of the existing seawall and start of the slope would form an effective wave break bench. As discussed in FSAR Section 2.4.5.3.2, the wave characteristics along the slope include a wave height of 2.24 feet and a wave period of 11.1 seconds and would produce a wave run-up of 3.0 feet given that the slope in this area is 12.5H:1V; the wave run-up would travel a lateral distance of 37.6 feet. With a period of 11.1 seconds, the average velocity of the wave during run-up would be 3.4 feet per second. As discussed in FSAR Section 2.4.5.3.2, the wave period could decrease after the waves break as they move onshore. However, the wave period of 11.1 seconds was used in the run-up modeling to produce conservative wave run-ups.

To further evaluate the velocity of the run-up, a shorter period wave was also examined. A wave with a wave height of 2.24 feet and a wave period of 4 seconds would produce a wave run-up of 1.1 feet and would travel a lateral distance of 13.8 feet. With a period of 4 seconds, the average velocity of the wave during run-up would be 3.4 feet per second.

Both of these run-up velocities are below the permissible velocities for the erosion protection methods discussed in the response to RAI 02.04.02-4.

From the Automated Coastal Engineering System (ACES) (U.S. Army Corps of Engineers) model, a number of other wave parameters including the velocity of water under the wave prior to run-up, can be obtained. At a water depth of 3.6 feet, the maximum velocity of water under the wave is 3.3 feet per second and would occur directly under the crest or trough of the wave. The 2.24 foot wave traveling across the slope would break at a depth of about 2.8 feet and the velocity of the water on the bottom below the crest or trough of the wave would be 3.7 feet per second. Both of these run-up velocities are below the permissible velocities for the erosion protection methods discussed in the response to RAI 02.04.02-4.

The action of waves breaking on the slope of the Fermi 3 elevated area that faces Lake Erie could provide additional forces that result in erosion. Where this is possible, rip-rap could be used to prevent erosion from waves. The ACES model was used to determine the size of rip-rap needed for a rubble mound revetment for waves with a height of 2.24 feet and wave period of 11.1 seconds. For the case of no damage to the structure, the D50 size would be 0.5 feet. If some damage was allowed, such as displacement of some of the rip-rap, but not to the extent that the filter layer would be exposed, the D50 size would be 0.35 feet. Typically, the thickness of the rip-rap layer would be three times the D50 size. In addition, a geotextile or stone filter layer would be installed under the rip-rap to prevent soil from being lost through the voids in the rip-rap.

Proposed COLA Revision

FSAR Section 2.4.2.3 will be updated to describe that erosion protection will be provided, where necessary, for the slopes of the Fermi 3 elevated area to preclude erosion during a postulated surge and seiche event.

Markup of Detroit Edison COLA
(following 2 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in the next submittal of the Fermi 3 COLA Revision 3. 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.

calculated discharge was 110 m^3/s (3,880 cfs) and the flow depth was 0.91 m (2.97 ft). The existing plant grade is at elevation 177.3 m (581.8 ft) NAVD88 and the nominal plant grade of safety related structures is at elevation 179.6m (589.3 ft) NAVD88. Therefore, the Fermi 3 nominal plant grade elevation would be approximately 1.38 m (4.53 ft) above the local PMP runoff flood level. No safety related structures would be impacted by flooding due to the local PMP runoff.

Given that the existing plant grade is at elevation 177.3 m (581.8 ft) NAVD 88, the most conservative water level due to PMP runoff at the Fermi 3 site is approximately 178.2 m (584.67 ft) NAVD 88. The nominal Fermi 3 plant grade of safety related structures is 179.6 m (589.3 ft) NAVD 88. Therefore, the Fermi 3 nominal plant grade elevation is approximately 1.4 m (4.5 ft) above the local PMP runoff flood level. Accordingly, no safety related structures will flood due to PMP runoff.

To prevent erosion on the 8% slopes of the elevated area, a storm water collection system will be designed to collect the runoff before it has a chance to reach the slopes. Figure 2.4-215 shows the conceptual storm water collection plan. The runoff will be collected in drop inlets where it will make its way to an outfall pipe at the north canal. Therefore the only runoff that the slopes will see is from direct rainfall onto the slopes. The slope area is small which will result in a small runoff. The small runoff spread over the length of the boundary of the elevated area will result in very low velocities. Erosion does not occur at very low velocities. **[START COM FSAR-2.4-002]** Detailed design will incorporate best industry practices included in "The Guidebook of Best Management Practices for Michigan Watersheds" to provide added erosion protection to the slopes, even though they are receiving very little runoff. These practices include mulching, seeding, sodding, soil management, trees, shrubs, and ground covers. To be conservative, erosion protection methods selected will be based on runoff velocities for a local PMP condition not taking credit for the storm water drains. **[END COM FSAR-2.4-002]**

Where necessary, erosion protection will be provided for breaking waves during a postulated surge/seiche event.

EF3 COL 2.0-14-A

2.4.3 Probable Maximum Flood on Streams and Rivers

This section determines the PMF of the Swan Creek Watershed, which is located hydrologically above Fermi 3. The guidance of ANSI/ANS-2.8-1992, which is the latest available standard, was used in determining the PMF (Reference 2.4-235).

$$L = g/2\pi * T^2 \tanh(2\pi d/L) \quad \text{[Eq. 5]}$$

Because L is on both sides of the equation, this equation must be solved through an iterative process.

Wavelengths associated with various points in the lake are shown in Table 2.4-223. Breaking wave heights at the toe of the seawall and at the toe of the berm are shown in Table 2.4-224.

2.4.5.3.2.4 Wave Run-up and Overtopping Rates

Wave run-up on the slope to the Fermi 3 grade elevation of 178.0 m (590.5 ft) plant grade datum or 179.6 m (589.3 ft) NAVD 88 was analyzed to determine if waves could impact the unit. The wave characteristics calculated for the toe of the berm were used as inputs to the ACES model to calculate wave run-up and overtopping rates on the berm. Because the berm is onshore, it was simulated as a smooth slope. An example of the inputs and calculated outputs for the on site configuration are shown in Figure 2.4-230. The analysis of wave run-up determined that waves could not directly impact Fermi 3.

2.4.5.4 Resonance

Resonance generated by waves can cause problems in enclosed water bodies, such as harbors and bays, when the period of oscillation of the water body is equal to the period of the incoming waves. However, the Fermi site is not located in an enclosed embayment. The full exposure to Lake Erie during PMWS conditions, plus the flat slopes surrounding the site area, results in a natural period of oscillation of the flooded area that is much greater than that of the incident shallow-water storm waves. Consequently, resonance is not a problem at the site during PMWS occurrence.

2.4.5.5 Sedimentation and Erosion

Fermi 3 does not rely on Lake Erie for a safety-related water source. Therefore, the loss of functionality of a safety-related water supply to Fermi 3 caused by blockages due to sediment deposition or erosion during a storm surge or seiche event is not a concern. The slope to Fermi 3 is appropriately designed to preclude significant erosion during the postulated storm surge.

Erosion protection from wave impacts are described in Section 2.4.2.3.

Attachment 3
NRC3-10-0018

Response to RAI Letter No. 28
(eRAI Tracking No. 4502)

RAI Question No. 02.04.05-9

NRC RAI 02.04.05-9

To meet the requirements of 100.20(c) and 52.79(a)(1)(iii), the NRC staff request that the applicant provide an update to information provided in the FSAR. All Lake Erie hourly lake-level data that were used to calculate the 100-year lake level were provided in an excel spreadsheet as a response to RAI 2.4.5-1. The staff used the information to verify the values provided in FSAR Table 2.4-210. The staff identified errors in Table 2.4-210. For the years 1970 through 1996, the maximum values in Table 2.4-210 are lower than maximum hourly water levels contained in the excel spreadsheet, and the minimum values in Table 2.4-210 are higher than the minimum hourly water levels contained in the excel spreadsheet. The values presented for 1997 through 2007 were found to be correct by the staff (i.e., the values corresponded with values in the excel spreadsheet). The applicant should resolve the inconsistencies and provide updated information and tables.

Response

The maximum and minimum water level values presented in FSAR Table 2.4-210 for the years 1970 through 1996 are based on the average daily value, whereas the maximum and minimum water level values presented for 1997 through 2007 are based on hourly recorded values. For consistency, FSAR Table 2.4-210 will be revised to show the maximum and minimum water level values based on hourly recorded values.

A proposed markup is attached. The information in the proposed markup is consistent with the data provided in the response to RAI 2.4.5-1.

Proposed COLA Revision

The proposed markups to FSAR Section 2.4.2.1, FSAR Table 2.4-210, and Figure 2.4-212 are attached. FSAR Section 2.4.2.1 refers to values in FSAR Table 2.4-210, and FSAR Figure 2.4-212 is a graphical representation of the information in FSAR Table 2.4-210. These markups reflect the revisions to FSAR Table 2.4-210.

Proposed changes to ER Section 2.3.1.1.3 and ER Table 2.3-11 are made to clarify the date range for water levels presented in the ER.

Markup of Detroit Edison COLA
(following 10 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in the next submittal of the Fermi 3 COLA Revision 3. 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.

runoff water levels, describes the capacity of drainage facilities, and shows that safety related facilities are adequately protected.

2.4.2.1 Flood History

Due to its proximity to the site, Lake Erie is the primary surface-water body to potentially impact Fermi 3. The Fermi site is located outside the realm of significant impact due to the flooding of local streams and rivers. The PMF of Swan Creek is discussed in Subsection 2.4.3. Following is a description of historical flooding of Lake Erie and other bodies of water surrounding Fermi 3.

Lake Erie

Lake Erie is in the Lake Erie Drainage Basin, which is a sub-basin of the Great Lakes Drainage Basin. The Lake Erie Drainage Basin is shown on Figure 2.4-203. The western basin of Lake Erie, along which Fermi 3 is located, is a very shallow basin with an average depth of 7.4 m (24 ft) and is partially restricted from the rest of Lake Erie by a chain of barrier beaches and islands.

Approximately 80 percent of Lake Erie's total inflow is from the Detroit River, 11 percent from precipitation, and the remaining 9 percent from tributaries flowing through watersheds in Michigan, Ohio, Pennsylvania, New York, and Ontario. Outflows from Lake Erie are not regulated; rather, outflows are controlled by the hydraulic characteristics of its outlet rivers.

The topography of the site is flat to gentle rolling plain and is located in the Swan Creek watershed, which is the smallest drainage basin within the region. The Swan Creek watershed has an elliptical-shaped basin, trending northwest-southeast, and generally distributes a small flow of water when compared to the capacity of Lake Erie.

The water levels of Lake Erie have been recorded from 1860 to the present by the Great Lakes Environmental Research Laboratory (GLERL). Extreme water levels, obtained from the Fermi Power Plant gauging station (ID 9063090), from 1967 to 2007, are shown on Figure 2.4-212. The data for these extreme water levels are shown on Table 2.4-210. The highest recorded water level of these extremes is ~~175.71 m (576.48 ft) NAVD 88, occurring in April of 1998.~~ Table 2.4-210 also lists the lowest recorded water level, of 171.9 m (563.9 ft) NAVD 88, which occurred in 1967 (Reference 2.4-228, Reference 2.4-234).

175.79 m (576.73 ft) NAVD 88, occurring in 1973 and 1985.

Recent flooding occurred within the Great Lakes Basin between 1985 and 1987. Precipitation over the entire Great Lakes Basin between November 1984 and April 1985 was 20 percent above average, and from May to December of 1985, precipitation was 27 percent above average. The 1985 spring runoff was 20 to 65 percent above normal, the highest in 20 years. The gauging station (ID 9063090) at the Fermi site on Lake Erie recorded a peak water level of 175.71 m (~~576.5~~ 576.47 ft) IGLD 85 on March 31, 1985.

On December 2, 1985, a storm with winds gusting up to 100 km/hour (62.14 mph) severely affected shorelines with western exposures. The peak elevation at the Fermi site during this storm event was 174.4 m (572.1 ft) IGLD 85. A later storm event caused a peak elevation of Lake Erie at the Fermi site of 175.7 m (576.4 ft) IGLD 85, recorded on February 7, 1986. Furthermore, a peak elevation of 175.6 m (576.0 ft) IGLD 85 was recorded on January 19, 1987.

<u>Swan Creek</u>

Swan Creek, located north of the Fermi site, typically experiences maximum flow rates in the spring and minimum flow rates in late summer. At its mouth (Section 16, T6S, R10E, Frenchtown Township, Monroe County) Swan Creek has a drainage area of approximately 275 km^2 (106 mi^2). The 10, 2, 1, 0.5, and 0.2 percent peak flow rates are estimated to be 70, 100, 120, 130, and 140 m^3/s (2500, 3700, 4100, 4600, and 5000 cfs), respectively (Reference 2.4-232)

<u>Stony Creek</u>

Stony Creek is located about 5 km (3 mi) southwest of the Fermi site. It typically experiences maximum flow rates in the spring and minimum flow rates in late summer. The 10, 2, 1, 0.5, and 0.2 percent peak flows are estimated to be 50, 80, 100, 120, and 140 m^3/s (1800, 2900, 3600, 4100, and 4900 cfs), respectively (Reference 2.4-233).

<u>River Raisin</u>

The River Raisin, located about 9.6 km (6 mi) southwest of the Fermi site, typically experiences maximum annual flooding in April and May. The largest flood (records begin in 1938) of the River Raisin occurred on March 29, 1950, and the second largest occurred on April 6, 1947. The 10, 2, 1, 0.5, and 0.2 percent chance peak flows are estimated to be 280, 420, 480, 540, and 650 m^3/s (10000, 15000, 17000, 19000, and 23000 cfs), respectively (Reference 2.4-241)

Table 2.4-210 Extreme Lake Levels for the Western Basin of Lake Erie at the Fermi Site (ID 9063090) (Sheet 1 of 2) [EF3 COL 2.0-13-A]

	NAVD 88		IGLD 85	
Year	Max (ft)	Min (ft)	Max (ft)	Min (ft)
*1967		563.90		**563.64**
1970	573.26	569.02	**573.00**	**568.76**
1971	573.05	568.73	**572.79**	**568.47**
1972	574.28	568.51	**574.02**	**568.25**
1973	575.11	570.84	**574.85**	**570.58**
1974	575.10	570.77	**574.84**	**570.51**
1975	574.52	570.59	**574.26**	**570.33**
1976	574.59	570.42	**574.33**	**570.16**
1977	573.62	569.05	**573.36**	**568.79**
1978	574.26	569.79	**574.00**	**569.53**
1979	573.37	568.61	**573.11**	**568.35**
1980	574.09	569.98	**573.83**	**569.72**
1981	573.49	570.51	**573.23**	**570.25**
1982	573.89	569.53	**573.63**	**569.27**
1983	574.10	570.53	**573.84**	**570.27**
1984	574.30	[illegible]	**574.04**	**570.49**
1985	574.82	569.97	**574.56**	**569.71**
1986	575.46	572.21	**575.20**	**571.95**
1987	574.65	570.35	**574.39**	**570.09**
1988	573.08	569.51	**572.82**	**569.25**
1989	573.36	568.86	**573.10**	**568.60**
1990	573.12	569.83	**572.86**	**569.57**
1991	573.72	569.26	**573.46**	**569.00**
1992	573.71	569.79	**573.45**	**569.53**
1993	574.52	570.60	**574.26**	**570.34**
1994	573.59	569.71	**573.33**	**569.45**
1995	573.70	569.10	**573.44**	**568.84**
1996	573.41	570.79	**573.15**	**570.53**
1997	575.59	569.33	**575.33**	**569.07**
1998	576.48	566.62	**576.22**	**566.36**
1999	574.45	567.63	**574.19**	**567.37**

Add Insert "1" here

Table 2.4-210 Extreme Lake Levels for the Western Basin of Lake Erie at the Fermi Site (ID 9063090) (Sheet 2 of 2) [EF3 COL 2.0-13-A]

Year	NAVD 88		IGLD 85	
	Max (ft)	Min (ft)	Max (ft)	Min (ft)
2000	573.58	565.99	**573.32**	**565.73**
2001	572.85	565.86	**572.59**	**565.60**
2002	573.41	564.92	**573.15**	**564.66**
2003	573.70	564.45	**573.44**	**564.19**
2004	573.47	567.43	**573.21**	**567.17**
2005	574.07	566.80	**573.81**	**566.54**
2006	573.89	565.75	**573.63**	**565.49**
2007	573.73	566.56	**573.47**	**566.30**

* The lowest elevation recorded was noted on a Nuclear Generation Memorandum NP-00-0064 dated August 16, 2000. Elevation has been confirmed by NOAA on 02/07/2008

Source: Reference 2.4-228, Reference 2.4-234

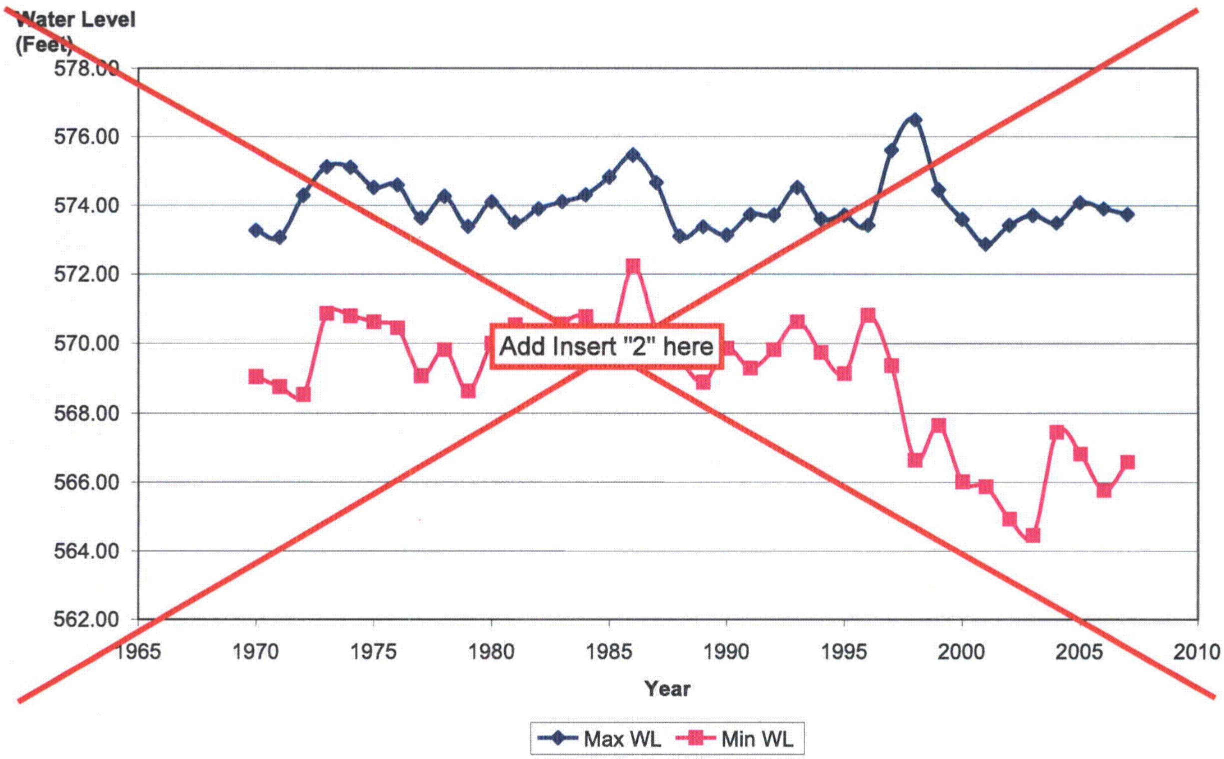
Insert "1":

	NAVD 88		IGLD 85	
Year	Max (ft)	Min (ft)	Max (ft)	Min (ft)
*1967		563.90		**563.64**
1970	574.04	567.63	**573.78**	**567.37**
1971	574.15	565.98	**573.89**	**565.72**
1972	575.80	565.96	**575.54**	**565.70**
1973	576.73	569.18	**576.47**	**568.92**
1974	576.60	569.38	**576.34**	**569.12**
1975	576.21	567.23	**575.95**	**566.97**
1976	575.74	569.52	**575.48**	**569.26**
1977	575.06	567.24	**574.80**	**566.98**
1978	574.71	567.05	**574.45**	**566.79**
1979	574.87	564.26	**574.61**	**564.00**
1980	576.13	567.66	**575.87**	**567.40**
1981	574.31	568.47	**574.05**	**568.21**
1982	575.62	566.66	**575.36**	**566.40**
1983	575.50	569.50	**575.24**	**569.24**
1984	575.50	569.39	**575.24**	**569.13**
1985	576.73	567.64	**576.47**	**567.38**
1986	576.61	570.42	**576.35**	**570.16**
1987	576.30	566.83	**576.04**	**566.57**
1988	574.23	568.19	**573.97**	**567.93**
1989	574.29	567.15	**574.03**	**566.89**
1990	575.60	567.37	**575.34**	**567.11**
1991	574.90	565.96	**574.64**	**565.70**
1992	574.65	567.89	**574.39**	**567.63**
1993	575.13	568.81	**574.87**	**568.55**
1994	574.45	567.37	**574.19**	**567.11**
1995	574.67	567.75	**574.41**	**567.49**
1996	574.61	566.56	**574.35**	**566.30**
1997	575.59	569.33	**575.33**	**569.07**
1998	576.48	566.62	**576.22**	**566.36**

	NAVD 88		IGLD 85	
Year	Max (ft)	Min (ft)	Max (ft)	Min (ft)
1999	574.45	567.63	**574.19**	**567.37**
2000	573.58	565.99	**573.32**	**565.73**
2001	572.85	565.86	**572.59**	**565.60**
2002	573.41	564.92	**573.15**	**564.66**
2003	573.70	564.45	**573.44**	**564.19**
2004	573.47	567.43	**573.21**	**567.17**
2005	574.07	566.80	**573.81**	**566.54**
2006	573.89	565.75	**573.63**	**565.49**
2007	573.73	566.56	**573.47**	**566.30**

* The lowest elevation recorded was noted on a Nuclear Generation Memorandum NP-00-0064 dated August 16, 2000. Elevation has been confirmed by NOAA on 02/07/2008

Figure 2.4-212 **Lake Erie Extreme Water Levels (1970-2007) NAVD 88** [EF3 COL 2.0-13-A]



Source: Reference 2.4-228, Reference 2.4-234

Insert “2”:

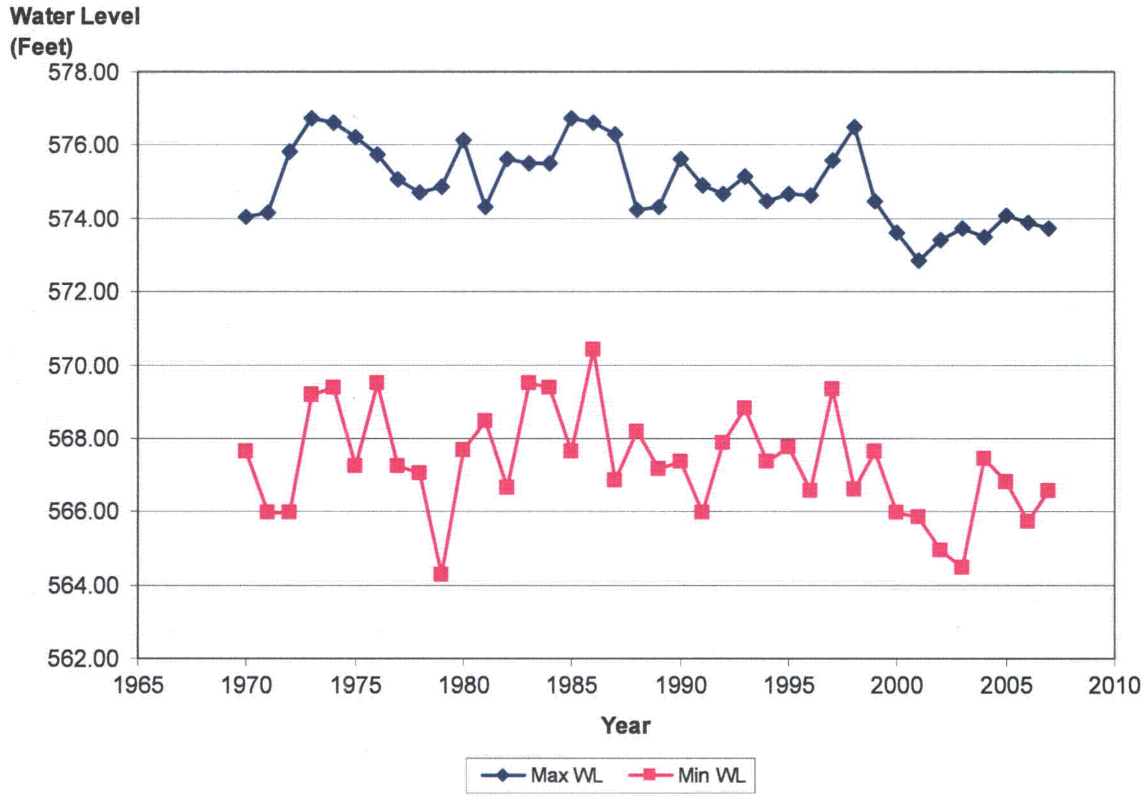

Water Level
(Feet)
578.00
576.00
574.00
572.00
570.00
568.00
566.00
564.00
562.00
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year
Max WL
Min WL

Table 2.3-8 shows the historical average Lake Erie water levels for the time period of 1918 through 2006 based on averages interpolated between two National Oceanic & Atmospheric Administration (NOAA) gauges, Toledo (9063085) and Fairport (9063053), and two Department of Fisheries and Oceans of Canada (DFO) gauges, Port Stanley (45132) and Port Colborne (45142) (Reference 2.3-12). The data in Table 2.3-8 does not include the gauge located at the Fermi site in this average (Reference 2.3-15 and Reference 2.3-16). This NOAA gauge is discussed in Subsection 2.3.1.1.3.

The intake structure and discharge for Fermi 3 will utilize the western basin of Lake Erie. The bathymetry of Lake Erie and Lake Saint Clair is shown on Figure 2.3-8 (Reference 2.3-11). Figure 2.3-8 shows that the western basin is much shallower than the other basins. Subsection 2.3.1.1.3 provides more detailed discussion of the Lake Erie western basin, including historical hydrological data, water characteristics, and local water bodies specifically in close proximity to the Fermi site.

2.3.1.1.3 **Lake Erie Western Basin**

The western basin of Lake Erie has many tributaries north and south of the Fermi site. The main tributaries of the western basin that are in close proximity to the Fermi site and could possibly impact or be impacted by Fermi 3 are the River Raisin, Swan Creek, and Stony Creek. The Detroit River is a farther distance from the site than these three tributaries, but further discussion on the river is provided due to its size, proximity and relative contribution to Lake Erie.

These tributaries have been evaluated in the discussion below due to the amount of water and sediment inflow distributed to the western basin and proximity to Fermi 3. As previously discussed, the majority of water inflow to Lake Erie is from the Detroit River. Regarding tributaries in close proximity to the site (Swan Creek, Stony Creek, and the River Raisin), the majority of water inflow comes from the River Raisin. Thus, the majority of water inflow and sediment transfer regarding tributaries closest to the site is primarily from the Detroit River and the River Raisin. Swan Creek and Stony Creek are located north and south of the site respectively. Swan Creek is located approximately 1.3 miles north of the site and Stony Creek approximately 3 miles southwest. These are much smaller tributaries with lower contributions to incoming water flow and sediment.

The entire Fermi site is located in the Swan Creek Watershed. The Swan Creek drainage basin will impact the site during certain storm events. The water body distributes minor flow, but under certain flood conditions this water body may have an impact locally on the site.

September December

The Fermi site has a station gauge (ID 9063090) within the vicinity of the Fermi 2 intake structure, monitored by the NOAA to monitor the water level at the Fermi site. The historical water levels of this gauge are shown in Table 2.3-9 and Table 2.3-11 for the period of 1996 through 2007 (Reference 2.3-19). For each month in this time period, the maximum and minimum recorded water levels are shown in Table 2.3-9 including the data and time of occurrence. For this same time period, Table 2.3-11 shows the ten highest and lowest recorded water levels, including date and time of occurrence.

Table 2.3-11 Extreme Recorded Lake Erie Water Levels

Station:	9063090	Begin Date:	~~19700713~~ 19960901
Name:	Fermi Power Plant, MI	End Date:	~~0080409~~ 20071231
Product:	High/Low	Units:	Feet
Datum:	IGLD 85	Quality:	Verified

Rank	Highest	Highest Date		Lowest	Lowest Date	
*1				563.64	19670216	07:00
1	576.22	19980409	14:00	564.19	20031113	06:00
2	575.46	19980217	21:00	564.66	20020310	02:00
3	575.35	19980321	02:00	565.49	20061201	20:00
4	575.33	19970313	21:00	565.60	20011026	00:00
5	575.32	19970228	01:00	565.73	20001217	17:00
6	575.21	19970607	19:00	566.30	20071106	14:00
7	574.93	19970412	07:00	566.36	19981111	09:00
8	574.78	19970722	10:00	566.40	20071223	21:00
9	574.76	19970501	22:00	566.49	20020201	16:00
10	574.74	19980507	18:00	566.54	20051106	18:00

* 1 is the lowest elevation of record that was noted on a Nuclear Generation Memorandum NP-00-0064 dated August 16, 2000. Elevation has also been confirmed by NOAA (National Oceanic & Atmospheric Administration) on 02/07/2008.

Source: Reference 2.3-19

Attachment 4
NRC3-10-0018

Response to RAI Letter No. 28
(eRAI Tracking No. 4503)

RAI Question No. 02.04.05-10

NRC RAI 02.04.05-10

To meet the requirements of 10 CFR Part 52.79(a)(1)(iii) and to support the staff's review of the application, the staff requests that the applicant correct and update information. In the response to RAI 2.4.5-8, the staff identified an error on Figure 3 related to wave runup. The variable "R" is incorrectly identified in the figure. The figure should be revised to accurately show "R" as the distance between the top of the wave and the center of the wave. It is currently shown as the distance between the top of the wave and the bottom of the wave. Also, the elevation of the wave runup should be included on Figure 3. Lastly, the appropriate sections of the FSAR should be updated with text reflecting that the elevation of wave runup plus probable maximum surge level is 0.8 ft below the elevation of Fermi 3 safety structures.

Response

A revision to the wave run-up figure has been provided as part of the FSAR mark-up included in the supplemental response to RAI 02.04.03 contained in Detroit Edison letter NRC3-10-0016, dated April 16, 2010. The revised figure shows the variable "R" as the distance between the top of the wave run-up and the center of the wave. In addition, the elevation of the wave run-up is also shown on the revised figure. A mark-up to FSAR Section 2.4.5.3.2.4 was also presented to reflect the distance of the wave run-up below the elevation of the Fermi 3 safety-related structures.

Proposed COLA Revision

None

Attachment 5
NRC3-10-0018

Response to RAI Letter No. 28
(eRAI Tracking No. 4504)

RAI Question No. 02.04.13-10

NRC RAI 02.04.13-10

To meet the requirements of 10 CFR Part 100.20 and 10 CFR Part 20 Appendix A, staff request additional information concerning the ground water conceptual model. In its RAI response, dated January 29, 2010, the applicant responded to RAI No. 02.04.13-9. In the response, the applicant describes the conceptual model as follows:

- 112 cubic meters of liquid from the equipment drain collection tank escapes to the aquifer due to a combined failure of the tank and the basement floor and/or walls,

- The 112 cubic meters of liquid is assumed to enter the aquifer instantly, and is modeled "as a volume of contaminated soil 56 m2 by 2 m deep" (so, a contaminated soil volume of 112 cubic meters).

Staff reviewed this response and the applicant' implementation in RESRAD OFFSITE and found that it is inconsistent with the conceptual model for two reasons:

1 - The applicant's description ignores the relationship between void volume and solid volume in the setup of the RESRAD source. Porosity needs to be accounted for and a much larger aquifer volume would comprise the source volume.

2 - The description mentions the leaching of contaminants from the contaminated zone to the aquifer. This implies that the contaminated soil is in the unsaturated zone, which is not the case for the described failure scenario. The scenario is the instant release of contaminated water into a pristine aquifer, rather than leaching with an initial release rate set to the equilibrium desorption release rate. Contaminant transport analysis would include the dynamics of sorption/desorption, starting with an initial sorbed mass of zero.

Therefore, based on the staff's review, the transport analysis should be re-evaluated for consistency between the conceptual model described and the implementation of that scenario in RESRAD OFFSITE or another appropriate code.

Response

In preparing the response to this RAI, the RESRAD-OFFSITE (NUREG/CR-6937) model presented in FSAR Section 2.4.13 was revised as described below.

1 - The applicant's description ignores the relationship between void volume and solid volume in the setup of the RESRAD source. Porosity needs to be accounted for and a much larger aquifer volume would comprise the source volume.

As shown in FSAR Table 2.4-234, the total porosity is 0.25. The postulated failure of a single equipment drain collection tank releasing 112 cubic meters (29,600 gallons) of contaminated water (80% of the tank's total volume) would produce a contaminated zone of 448 cubic meters. The revised RESRAD-OFFSITE incorporates this revised source volume.

2 - The description mentions the leaching of contaminants from the contaminated zone to the aquifer. This implies that the contaminated soil is in the unsaturated zone, which is not the case for the described failure scenario. The scenario is the instant release of contaminated water into a pristine aquifer, rather than leaching with an initial release rate set to the equilibrium desorption release rate. Contaminant transport analysis would include the dynamics of sorption/desorption, starting with an initial sorbed mass of zero.

FSAR Section 2.4.13 presents the analysis of the postulated failure of a single equipment drain collection tank releasing 112 cubic meters of contaminated water to a 448 cubic meter source volume/contaminated zone in the environment surrounding the Radwaste Building. The leaching of radioactivity from this 448 cubic meter contaminated zone to a uniform, horizontal layer in the aquifer below the Radwaste building is accomplished in the RESRAD-OFFSITE model by setting the primary contamination leaching rate into the uniform, horizontal layer to 525,600/year (1/minute). The use of this high leaching rate in the RESRAD-OFFSITE model is consistent with the guidance provided in BTP 11-6.

For this model, the impact of a postulated failure of a single equipment drain collection tank on two receptors is examined. The receptors that are considered in the analysis are:

1) An off-site well to the west where the flow path to this off-site well is based on the hydraulic gradient at the site, and

2) Lake Erie to the east where, as described in FSAR Section 2.4.13, the flow path is based on a hydraulic gradient at the site that would result from the securing of off-site quarry dewatering operations (FSAR Section 2.4.12.3.1).

Note: Piezometric head contour maps are presented in FSAR Figure 2.4-246 through Figure 2.4-249.

For each of these receptors, the ground water transport through two uniform, horizontal layers is estimated (see new FSAR Figure 2.4-266 presented in the COLA markup accompanying this response);

1) Rock fill layer using the following properties:

- Distribution coefficients (Kd) used in the estimate were the minimum Kd values from those locations in the general area of postulated release and the flow path to the receptor. Kd values for specific radionuclides were presented in Detroit Edison letter NRC3-10-0004, dated January 29, 2010 (ML100331451). Minimum Kd values were used in the estimate to account for potential uncertainties associated with the potential variability of the subsurface conditions and to minimize the mitigation from sorption/desorption in the estimate.

- The highest hydraulic conductivity of the rock fill from those locations in the general area of postulated release and flow path to the receptor was utilized. A hydraulic conductivity of 130,305 meters per year was used for the off-site well to the west and a hydraulic conductivity of 197,719 meters per year was used for Lake Erie to the east.

- The hydraulic gradient in the rock fill to the east of the Radwaste Building is utilized to estimate ground water transport in this layer in the western direction towards the off-site well. A hydraulic gradient of 0.0007 was used (FSAR Section 2.4.12.3.2). The actual hydraulic gradient in the rock fill is away from the nearest off-site potable water well and towards the Radwaste Building (i.e., to the east). The direction of the hydraulic gradient in the rock fill was conservatively assumed to reverse to estimate a western ground water transport in this layer towards the well.

  The hydraulic gradient in the Bass Islands aquifer is utilized to estimate the ground water transport in this layer in the eastern direction towards Lake Erie. A hydraulic gradient of 0.002 was used (FSAR Section 2.4.12.3.2).

Note: For the released contaminated water to enter the rock fill, the level of water in the Radwaste Building following the failure of a single equipment drain collection tank must be greater than sixteen feet above the floor.

2) Bass Islands formation using the following properties:

- All Kd values were set to zero to preclude the mitigating dynamics of sorption/desorption in the estimate.

- The hydraulic conductivity of 365.16 meters per year (1 meter per day) was used for the Bass Islands formation (FSAR Section 2.4.12.2.4.2).

- The hydraulic gradient of 0.002 was used for the Bass Islands aquifer (FSAR Section 2.4.12.3.2).

The new estimated releases from the postulated failure of a single equipment drain collection tank releasing 112 cubic meters of contaminated water to a 448 cubic meter contaminated zone in the environment surrounding the Radwaste Building and then leaching the radioactivity from this 448 cubic meter contaminated zone to a uniform, horizontal layer in the aquifer below the Radwaste building are:

Off-site well via the rock fill – negligible concentrations of any radioisotopes in the nearest offsite potable water well to the west.

Off-site well via the Bass Islands formation – negligible concentrations of any radioisotopes in the nearest off-site potable water well to the west.

Lake Erie via the rock fill - small concentrations of many radioisotopes are estimated to be released in Lake Erie. The estimated concentration for each radioisotope is less than six percent (Fe-55) of the limits in 10 CFR 20 Appendix B, Table 2, Column 2 and the unity rule is satisfied.

Lake Erie via Bass Islands formation - negligible concentrations of any radioisotopes are released to Lake Erie to the east.

To aid in the NRC staff's review of these revised estimates, the electronic input files for the four RESRAD-OFFSITE cases are provided in Enclosure 1.

Proposed COLA Update

A mark-up for FSAR Section 2.4.13 is attached to reflect the updated RESRAD analysis described above.

NRC3-10-0018
RAI 02.04.13-10

Enclosure 1

CD Containing RESRAD-OFFSITE Input/Output files
(following 1 page)

Directory of D:\

```
05/04/2010  01:37 PM    <DIR>          Files
               0 File(s)              0 bytes

 Directory of D:\Files

05/04/2010  01:37 PM    <DIR>          .
05/04/2010  01:39 PM    <DIR>          ..
05/04/2010  09:05 AM   30,768 REV_2_DTE_LE_ESBWR_BI_NO_KD_LONG.ROF
05/04/2010  09:05 AM   30,983 REV_2_DTE_LE_ESBWR_LONG_ROCK_FILL_KD.ROF
05/04/2010  09:05 AM   30,764 REV_2_DTE_WELL_ESBWR_BI_NO_KD_LONG.ROF
05/04/2010  09:05 AM   30,976 REV_2_DTE_WELL_ESBWR_LONG_ROCK_FILL_KD.ROF
               4 File(s)        123,491 bytes

     Total Files Listed:
               4 File(s)        123,491 bytes
```

Markup of Detroit Edison COLA
(following 20 pages)

The following markup represents how Detroit Edison intends to reflect this RAI response in the next submittal of the Fermi 3 COLA Revision 3. 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.

EF3 COL 2.0-24-A

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 volumes results in the release of these liquids to the groundwater environment via the liquid pathway.

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 herein.

2.4.13.2 **Groundwater Analysis**

The discussion in Subsection 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.

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This section provides ~~a~~ conservative and bounding analys~~is~~ 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 analy~~sis is~~ described, and the results are summarized. The radionuclide concentrations are compared against the regulatory limits.

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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 mitigation 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.

Two release scenarios are considered. For the first scenario, the release is assumed to occur in the Bass Islands aquifer. Based on negligible radioisotope concentration results, a second scenario conservatively assumes the release occurs in the Rock Fill above the Bass Islands aquifer; approximatley sixteen feet above the actual postulated release location at the bottom of the Radwaste Building.

Radwaste tanks outside of containment are located on levels B1F and B2F of the radwaste building as shown on DCD Figure 1.2-25. 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 (see DCD Table 2.0-2, for Subsection 2.4.13).

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The scenario assumes that one of the equipment drain collection tanks fails and its contents are released directly 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.

these

2.4.13.2.2 **Transport Model**

Based on the COL stage investigations of the Fermi 3 power block and surrounding area documented in Subsection 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 80 percent of the liquid volume (112 m^3 or 29,600 gal) is assumed to be released following the guidance provided in BTP 11-6. Following tank rupture, it is conservatively assumed that a pathway is created that allows the entire 112 m^3 to enter the ~~groundwater (unconfined aquifer)~~ instantaneously.

Bass Islands aquifer or Rock Fill (dependent on the release scenario)

Based on the total porosity (0.25) of the surrounding subsurface materials, the release volume is increased to 448 m3 once outside the building.

The assumption of instantaneous 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. 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.

Furthermore, for the conservatively assumed Rock Fill release scenario, the liquid release would also need to reach an elevation of more than sixteen feet above the floor of the Radwaste Building.

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. Subsection 2.4.12.3.1 describes potential pathways in the bedrock (Bass Islands aquifer). As described in Subsection 2.4.12.3.1 there are two potential pathways for groundwater:

or the Rock Fill

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The Rock Fill release scenario provides for the limiting results.

- 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.

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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 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 Lake Erie, the source is assumed to be the closest eastern side of the radwaste building.

Each

~~The~~ analysis allows for radionuclide decay during transport by groundwater, and considers this decay in the analysis. Radionuclide for the conservative Rock Fill release scenario. Adsorption by the surrounding soils is conservatively neglected for the Bass Islands aquifer release scenario.

transport by groundwater is affected by adsorption by the surrounding soils.

The Fermi site is assumed to continually receive the average annual precipitation; precipitation that does not run off or is not lost to evapotranspiration infiltrates through the unsaturated zone and into the groundwater.

(only credited in the Rock Fill release scenario)

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Parameters such as distribution coefficients, hydraulic conductivity,porosity, and hydraulic gradient used in the analysis are provided in Table 2.4-234. Dilution of the radionuclide source term during the instantaneous release outside the radwaste building is not modeled in the analysis. Additionally, all radioisotope constituents of the source term in DCD Table 12.2-13a are included in the analysis. Values were selected to conservatively bound the hydrogeologic properties from the surface to the bottom of the Bass Islands Aquifer. As an example of the conservatism, Subsection 2.4.12.2.4.2 reports the maximum average hydraulic conductivity of the Bass Islands as 2.1 meters/day (767 meters/year). The groundwater analyses were performed with a value of 197,719 meters/year based on the rock fill. This input alone represents a factor of conservatism of approximately 250. This conservatism was selected to provide a bounding analysis.

by assumption of a very large leaching rate (i.e., 1/minute or 525,600/year)

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that represent both

and the Rock Fill

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 neither 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 thelaboratory analysis where the concentration predicted, crediting decay only, exceeded the limit.

for the vicinity of the flow path considered

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.

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

The total porosity value was used to be conservative with respect to available information for other areas of the Bass Islands formation in the State of Michigan (Reference 2.4-295). The effective porosity value was initially selected from a report of similar material (i.e.,dolomite), Reference 2.4-291, and confirmed to be conservative through sensitivity cases with RESRAD-OFFSITE.

The travel times of the groundwater movement from the radwaste building to the receptor were computed from a variation of Darcy'sLaw:

$$t = \frac{x}{V} = \frac{x}{KI/\theta}$$

Where: t = time to move distance x (yr)

x = distance of contaminant movement (m)

V = average interstitial groundwater velocity (m/yr)

K = hydraulic conductivity (m/yr)

I = hydraulic gradient

θ = effective porosity

The values of parameters used are shown in Table 2.4-234.

2.4.13.2.3 **Radionuclide Transport Analysis**

Radionuclide concentrations in groundwater along the transport pathway toward the closest off site well or Lake Erie as a result of anaccidental release of an equipment drain collection tank contents directly to the groundwater were modeled using RESRAD-OFFSITE (Reference 2.4-292). ~~Except for the distance from the radwaste building to the receptors and the dispersivities, the inputs for both postulated flow paths are the same.~~

The RESRAD-OFFSITE computer code evaluates the radiological dose to an individual who is exposed while located outside the area of initial (primary) release. The primary release, which is the source of allthe radionuclides modeled by the code, is a layer of soil below the radwaste building. The code models the movement of the radionuclides from the primary release to user-defined points along the transport pathway.

The groundwater pathway mechanism is a first-order transport model that considers the effects of different transport rates for radionuclides and progeny nuclides, while allowing decay during the transport process. Concentrations of each radionuclide transmitted to the assumed drinking water source (closest off site well or Lake Erie) are determined by the transport through the groundwater system, dilution by groundwater and infiltrating surface water from the overburden soils, adsorption, and decay.

Any radionuclides at the point of analysis are assumed to remain at the analysis receptor point for a period of one year.

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For the RESRAD-OFFSITE analys~~is,~~ the longitudinal and transverse horizontal dispersivity values to the closest off site well and Lake Erie were estimated using Reference 2.4-292 through Reference 2.4-294. The values used in the analys~~is are~~ shown in Table 2.4-234.

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2.4.13.2.4 **Comparison with 10 CFR 20 ECL**

~~Table 2.4-235 lists the radionuclides predicted at the closest off site well and compares their concentrations to 10 CFR 20, Appendix B, Table 2, Column 2 limits. All radionuclide concentrations are under the limits. The~~

-235

~~predicted activity with respect to the 10 CFR 20 limits for Strontium-90 is a factor of 7.9 under the limits. 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.~~

For the release to the Rock Fill towards Lake Erie, radioisotope concentrations do potentially exist in Lake Erie.

Fe-55

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Table 2.4-~~236~~ lists the radionuclides predicted at Lake Erie and compares their concentrations to 10 CFR 20, Appendix B, Table 2, Column 2 limits. All radionuclide concentrations are under the limits. The predicted activity with respect to the 10 CFR 20 limits for ~~Strontium-90~~ is a factor of ~~4~~ under the limits. Meeting 10 CFR 20 limits at Lake Erie 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. Results are summarized in Table 2.4-235 ~~and Table 2.4-236.~~ As shown in Table 2.4-235 ~~and Table 2.4-236~~, the sum of fractions for the mixtures at ~~the closest off site well and at~~ 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 CFR20.1302 are met.

Insert 1

Two release scenarios were evaluated. The first release scenario assumed an instantaneous liquid release directly into the Bass Islands aquifer. This is the expected release scenario based on the bottom floor elevation of the Radwaste building and the top elevation of the Bass Islands aquifer (See Figure 2.4-266). For the Bass Islands release scenario, no distribution coefficients are considered. The Bass Islands aquifer release scenario resulted in no radioisotope concentrations in drinking water from Lake Erie or the closest offsite well.

The second release scenario conservatively assumed an instantaneous liquid release directly into the rock fill approximately sixteen feet above the actual release location. The hydraulic gradient in the overburden rock fill is downward from the closest offsite well towards the Radwaste building (i.e., towards the eastern direction), so flow in the overburden rock fill would be towards Lake Erie to the east; therefore, a release from the Radwaste building would flow in the direction of Lake Erie and not to west in the direction of the closest offsite well. Although the hydraulic gradient in the rock fill does not support flow in the direction of the closest offsite well, this scenario was conservatively evaluated assuming the hydraulic gradient towards the radwaste building from the well was instead towards the well. Even under these assumed conditions, no radioisotope concentrations were in the drinking water from the closest offsite well.

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add for each Kd
"(Off-Site Well/Lake Erie)"

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 /5894
Cesium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	1078 /1078
Cobalt Kd (cm^3/g)	Radionuclide-specific distribution coefficient	640 /1513
Iron Kd (cm^3/g)	Radionuclide-specific distribution coefficient	2.88 /4.2
Manganese Kd (cm^3/g)	Radionuclide-specific distribution coefficient	394 /588
Ruthenium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	42.9 /265
Silver Kd (cm^3/g)	Radionuclide-specific distribution coefficient	0.41 /2.12
Strontium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	0.44 /33.1
Yttrium Kd (cm^3/g)	Radionuclide-specific distribution coefficient	3183 /7366
Zinc Kd (cm^3/g)	Radionuclide-specific distribution coefficient	16.7 /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
Hydraulic conductivity (m/yr)	A coefficient of proportionality describing the rate at which water can move through a permeable medium	~~197,719~~ 365.16 (Bass Islands Aquifer) 130,305 (Rock Fill towards Off-Site Well) 197,719 (Rock Fill towards Lake Erie)
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~~ 0.002 (Bass Islands Aquifer and conservatively assumed in Rock Fill towards Lake Erie) 0.0007 (assumed in Rock Fill to Off-Site well)
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

Lake Erie (Rock Fill Release Scenario)

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]

Insert 2 Here

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	4.57E-15	2.00E-07	2.28E-08
I-132	6.42E-10	1.00E-04	6.42E-06
La-140	7.92E-07	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

Lake Erie (Rock Fill Release Scenario)

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**

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Table 2.4-235 (Page 1 of 2) – Comparison of Liquid Release Concentrations With 10 CFR 20 Concentrations – Lake Erie (Rock Fill release scenario)

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration / 10 CFR Limit
Ac-227	3.75E-22	5.00E-09	7.49E-14
Ag-110m	3.62E-09	6.00E-06	6.04E-04
Ba-140	1.81E-07	8.00E-06	2.26E-02
Co-60	1.51E-17	3.00E-06	5.02E-12
Cr-51	1.03E-05	5.00E-04	2.07E-02
Cs-134	3.27E-23	9.00E-07	3.63E-17
Cs-137	8.57E-11	1.00E-06	8.57E-05
Cu-64	1.31E-11	2.00E-04	6.56E-08
Fe-55	5.23E-06	1.00E-04	5.23E-02
Fe-59	4.66E-10	1.00E-05	4.66E-05
Fr-223	5.17E-24	8.00E-06	6.46E-19
H-3	7.62E-06	1.00E-03	7.62E-03
I-129	2.26E-14	2.00E-07	1.13E-07
I-132	1.60E-10	1.00E-04	1.60E-06
I-134	1.14E-32	4.00E-04	2.86E-29
La-140	2.03E-07	9.00E-06	2.26E-02
Mn-54	5.72E-26	3.00E-05	1.91E-21
Mo-99	1.91E-08	2.00E-05	9.54E-04
Na-24	2.75E-11	5.00E-05	5.50E-07
Nb-93m	2.19E-16	2.00E-04	1.09E-12
Nb-95	3.52E-07	3.00E-05	1.17E-02
Nb-95m	1.59E-09	3.00E-05	5.32E-05
Ni-63	2.90E-07	1.00E-04	2.90E-03
Np-239	4.72E-08	2.00E-05	2.36E-03
P-32	2.49E-08	9.00E-06	2.76E-03
Pa-231	3.74E-22	6.00E-09	6.24E-14
Pb-211	3.75E-22	2.00E-04	1.87E-18
Pr-144	8.62E-16	2.00E-05	4.31E-11
Pu-239	1.73E-11	2.00E-08	8.63E-04
Ra-223	3.75E-22	1.00E-07	3.75E-15
Re-187	5.60E-20	8.00E-03	7.00E-18
Rh-103m	7.71E-14	6.00E-03	1.28E-11
Ru-106	2.66E-18	3.00E-06	8.88E-13
Sr-89	3.55E-16	8.00E-06	4.43E-11
Sr-90	8.53E-09	5.00E-07	1.71E-02
Tc-99	6.64E-13	6.00E-05	1.11E-08
Tc-99m	1.84E-08	1.00E-03	1.84E-05
Te-129	1.53E-07	4.00E-04	3.83E-04
Te-129m	2.35E-07	7.00E-06	3.36E-02
Te-132	1.56E-10	9.00E-06	1.73E-05
Th-227	3.69E-22	2.00E-06	1.85E-16
Th-231	1.91E-20	5.00E-05	3.83E-16
U-235	1.92E-20	3.00E-07	6.39E-14

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration / 10 CFR Limit
W-187	5.77E-11	3.00E-05	1.92E-06
Y-90	8.44E-09	7.00E-06	1.21E-03
Zn-65	7.22E-08	5.00E-06	1.44E-02
Zr-93	3.88E-15	4.00E-05	9.71E-11
Zr-95	2.16E-07	2.00E-05	1.08E-02
SUM			**2.26E-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-15	2.00E-07	2.82E-08
I-132	4.00E-11	1.00E-04	4.00E-07
I-134	3.44E-33	4.00E-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

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**

Figure 2.4-266 Conceptual Model for Groundwater Transport Analysis (Looking North)