## PMFermiCOLPEm Resource

**From:** Berrios, Ilka
**Sent:** Monday, November 23, 2009 11:08 AM
**To:** Misenhimer, David
**Cc:** Kevern, Thomas; FermiCOL Resource
**Subject:** Fermi RAI responses
**Attachments:** Fermi 3 Response to RAI Letter #15.pdf

David,

Attached file is the response to Fermi RAIs 14.3.2-1. Please review this response and provide feedback in the next 30 days.

If a you have any questions or need a conference call with Fermi, please let me know.

Thanks,

*Ilka T. Berrios*
Project Manager
NRO/DNRL/NGE1
301-415-3179
MS: T-6D38M

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

10 CFR 52.79

November 20, 2009
NRC3-09-0035

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 R. Hale (USNRC) to Jack M. Davis (Detroit Edison), "Request for Additional Information Letter No. 14 Related to the SRP Sections 13.03 and 14.03.02 for the Fermi 3 Combined License Application," dated October 7, 2009
3) Letter from Jerry R. Hale (USNRC) to Jack M. Davis (Detroit Edison), "Request for Additional Information Letter No. 15 Related to SRP Sections 02.04.02, 02.04.05 and 02.04.13 for the Fermi 3 Combined License Application," dated October 7, 2009

Subject: Detroit Edison Company Response to NRC Request for Additional Information Letters No. 14 & 15

In the referenced letters, the NRC requested additional information to support the review of certain portions of the Fermi 3 Combined License Application (COLA). The responses to the following Requests for Additional Information (RAIs) are provided as Attachments 1 through 6 of this letter:

| | |
|---|---|
| • RAI Question 14.03.02-1 | Structural and Systems Engineering - ITAAC |
| • RAI Question 02.04.02-3 | Floods |
| • RAI Question 02.04.13-8 | Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters |
| • RAI Question 02.04.05-2 | Probable Maximum Surge and Seiche Flooding |
| • RAI Question 02.04.05-3 | Probable Maximum Surge and Seiche Flooding |
| • RAI Question 02.04.05-4 | Probable Maximum Surge and Seiche Flooding |

The responses to the remaining NRC RAIs contained in the Reference 2, will be provided to the NRC by the requested date.

Information contained in these responses will be incorporated into a future COLA submission as described in the RAI response.

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 20th day of November 2009.

Sincerely,

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

Attachments:
1) Response to RAI Letter No. 14 (Question No. 14.03.02-1)
2) Response to RAI Letter No. 15 (Question No. 02.04.02-3)
3) Response to RAI Letter No. 15 (Question No. 02.04.13-8)
4) Response to RAI Letter No. 15 (Question No. 02.04.05-2)
5) Response to RAI Letter No. 15 (Question No. 02.04.05-3)
6) Response to RAI Letter No. 15 (Question No. 02.04.05-4)

cc:
Jerry Hale, NRC Fermi 3 Project Manager
Ilka Berrois, NRC Fermi 3 Project Manager
Bruce Olsen, NRC Fermi 3 Environmental Project Manager
Fermi 2 Resident Inspector
NRC Region III Regional Administrator
NRC Region II Regional Administrator
Supervisor, Electric Operators, Michigan Public Service Commission
Michigan Department of Environmental Quality
Radiological Protection and Medical Waste Section

**Attachment 1**
**NRC3-09-0035**

**Response to RAI Letter No. 14**
**(eRAI Tracking No. 3575)**

**RAI Question No. 14.03.02-1**

**NRC RAI 14.03.02-1**

*Section 2.4.1 ITAAC FOR BACKFILL UNDER CATEGORY I STRUCTURES of Part 10 ITAAC states that: "Not applicable since no compactable backfill will be placed under Fermi 3 Category I structures." Confirm that the above statement also applies to the supporting foundation medium for the FWSC structures. If not, discuss key elements of ITAAC that will be applied to the compactable backfill fill medium.*

**Response**

Per Fermi 3 FSAR, Rev. 1, Section 2.5.4.3 states the following:

> *"The FWSC foundation base is within fill material as shown on Figure 2.5.4-202; however, the existing subsurface materials including fill, lacustrine and glacial till are to be removed and backfill consisting of lean concrete will reestablish the foundation grade of the FWSC."*

FSAR Figure 2.5.4-202 shows the lean concrete backfill under the FWSC with the base of the backfill founded on the Bass Island Group bedrock. As described in FSAR, Section 2.5.4.5.4.2, the lean concrete used as fill under the FWSC will be proportioned, tested and the placement controlled in accordance with Regulatory Guide 1.142.

Due to the non-compactable characteristics of lean concrete, the statement in ITAAC Part 10, Section 2.4.1, is confirmed to be applicable to the FWSC structures.

**Proposed COLA Revision**

None required

**Attachment 2**
**NRC3-09-0035**

**Response to RAI Letter No. 15**
**(eRAI Tracking No. 3776)**

**RAI Question No. 02.04.02-3**

**NRC RAI 02.04.02-3**

*To meet the requirements of GDC 2 and 10 CFR 52.79(a)(31), and to support the staff's review of the application, information concerning the construction impacts from the Fermi 3 site should be discussed and evaluated. Please provide an evaluation of impacts of surface runoff from Unit 3 to Unit 2 under a worst case scenario (PMP and all storm drains blocked in Fermi 3), incorporating the slopes and other relevant factors of potentially downgradient land in the vicinity of both units. Provide an illustration of the routes taken by runoff in the vicinity of Units 2 and 3 during the worst case scenario. Describe the function of the French Drains northeast of the proposed nuclear island for Unit 3 and if any flow contribution is being accounted for in the flooding scenario.*

During a subsequent conference call on Tuesday, October 6, 2009, the NRC also provided an additional question related to potential flooding from the Circulating Water system external to the power block. Detroit Edison agreed to provide the response to this additional question as part of the response to RAI 02.04.02-3. The response to this additional question follows the response to RAI 02.04.02-3.

**Response**

Previously, an overall topographical drawing was provided (reference e-mail from Norm Peterson, Detroit Edison, to Mark Tonacci, NRC, dated August 21, 2009, 3:01 PM (ML092570338)) that was developed by combining the Fermi 3 area topographical drawing with a Fermi 2 drawing showing elevation points. The Fermi 3 plant layout, showing the elevated area, was superimposed on the drawing. The topographical drawing and the Fermi 2 drawing with the elevation points are both in plant datum. The grade elevation for Fermi 3 is 590.5 in plant datum (589.3 NAVD88 datum). Each line on the topographical map and the Fermi 3 elevated area represents one foot of elevation.

The Fermi 2 local PMP is described in the Fermi 2 UFSAR, Section 2.4.2.3.

As described in the Fermi 2 UFSAR, Section 2.4.2.3, flooding due to a local PMP on the adjacent 2-square mile drainage area west of the plant site was examined. The calculated PMP discharge for this case is 25,000 cfs. The capacity of the assumed flow area is 31,500 cfs with a water elevation of 582 feet plant datum. The difference between the capacity at the 582 foot elevation and the calculated discharge rate provides a margin of 6,500 cfs. Fermi 2 plant grade is at approximately 583 feet plant datum. Thus, the maximum water elevation at peak flow due a local PMP on the adjacent area west of the plant site would be more than 1 foot below plant grade. The maximum PMP discharge for the elevated area of Fermi 3 is approximately 3,100 cfs (FSAR, Figure 2.4-216). Even if this entire flow rate were to pass through the same area as the assumed flow area, the discharge rate of 3,100 cfs is less than the available margin of 6,500 cfs. Therefore, the elevated area for Fermi 3 will not impact the local PMP determination for the area to the west of the plant site.

The Fermi 2 UFSAR, Section 2.4.2.3, also describes the impact from the local PMP falling on the plant site itself. Fermi Unit 2 UFSAR Section 2.4.2.3 states the following:

> *"With respect to that portion of a local PMP falling on the plant site itself, including roof structures, runoff overflowing the roof parapets and from the downspouts, assuming that the site drainage system was completely blocked, would flow overland under conditions of site gradient to lower elevations surrounding the site and to Lake Erie itself."*

As described in Section 2.4.2.3, in this case the runoff is expected to flow overland under conditions of site gradient to lower elevations surrounding the site and then to Lake Erie. Fermi 2 door sills on safety-related structures are at least 6 inches above plant grade. Ponded water under PMP conditions (assuming blocked site drainage system) should drain overland prior to reaching the door sills on safety-related structures.

The existing area where Fermi 3 will be located is currently relatively flat. During a local PMP event, the water will pond and then run off. Based on the site topography the runoff would be expected to be in the direction of the western canal areas and southern lagoon. Runoff from the raised area associated with Fermi 3 (assuming that the drains are blocked) will flow in several different directions. The areas on the western side of the raised area would be expected to run off towards the west. The areas on the southwest, south and southeast would be expected to run off towards the south lagoon. The areas on the north and northeast side of the raised area would be expected to run off towards the vicinity of Fermi 2. Based on the topography in the vicinity of Fermi 2, the flow pattern would run off towards the northwest to the north lagoon.

The purpose of this assessment is to demonstrate that any changes to the runoff patterns due to Fermi 3 will not adversely impact Fermi 2. This assessment was performed in two steps. The first step was to determine any changes to the runoff patterns. The second step was to evaluate the changes to the runoff patterns, if necessary. For this assessment, the following assumptions were made:

- The land use (and therefore curve number) for the runoff areas that could impact Fermi 2 will not change with the addition of Fermi 3. Fermi 3 is essentially replacing existing parking lot, buildings, and disturbed areas with other parking lots, buildings, and disturbed areas. The areas around Fermi 2, including the switchyard are not impacted by the addition of Fermi 3.

- The limiting local PMP with all drains clogged is assumed. Consistent with the Fermi 3 FSAR, Section 2.4.2.3, the rainfall rate is 69.6 inches per hour. The french drains located on the Fermi 2 site take flow from the Fermi 2 site area and route it to two outfalls located on the north canal. As described above it is assumed during a local PMP event that all drains (including the Fermi 2 french drains) are clogged and all flow drained is overland. During smaller storm events, these drains would be used. Fermi 3 has a similar system for its local drainage. Local drainage for smaller storm events will be collected in inlets and piped to the North Canal. As noted, these drains are conservatively not credited in the evaluation of the local PMP.

Figure 1 (attached) shows the proposed Fermi 3 layout superimposed on the existing drainage basin. As shown in Figure 1, the proposed Fermi 3 elevated area could result in increased area for runoff to flow towards Fermi 2 as compared to the existing site topography. This excess area for runoff is shown more specifically on Figure 2 (attached). Figure 2 was developed by overlaying the existing drainage basins from Figure 1 with the final grade drainage basins from FSAR figure 2.4-2 15. The excess area flowing towards Fermi 2 is the area that drains elsewhere during existing conditions, but will flow toward Fermi 2 under developed conditions. The excess drainage area that could drain towards Fermi 2 is approximately 1.18 acres.

Thus, there is the potential for increased runoff to enter the Fermi 2 area due to the development of Fermi 3. An assessment of the significance of this additional runoff follows.

In addition to showing the proposed Fermi 3 layout superimposed on the existing drainage basin, Figure 1 also shows the runoff flow patterns as the water enters the Fermi 2 area from the northeast side of the Fermi 3 elevated area. As the water enters the Fermi 2 area, the runoff will follow the drainage pattern, as depicted by the flow arrows on Figure 1, to the existing roads northwest until it reaches the northern lagoon where it continues flowing north to Swan Creek. This flow pattern is away from the Fermi 2 safety related structures.

The discharge rate from additional Fermi 3 areas flowing towards Fermi 2 under a local PMP scenario and all drains blocked in Fermi 3 is determined below:

The flow rate due to the storm is determined using the following relationship:

$$Q = C * I * A \quad \text{Equation (1)}$$

Where:

Q = Flow Rate in cubic feet per second (cfs)
C = Coefficient of discharge (dimensionless) = 1.0.
I = Storm Intensity (in/hr)
A = Drainage Area (acres)

A = 1.18 acres
I = 69.6 in/hr

Thus, Q = 1.0 * 69.6 in/hr * ft/12 in * hr/3600 sec * 1.18 acres * 43,560 $ft^2$/acre
= 82.8 cfs

The flow capacity of the area is determined using Manning's Equation

$$Q = \frac{1.49 * A * R_h^{2/3} * S^{1/2}}{n} \qquad \text{Equation (2)}$$

Where:

$Q$ = Flow Rate in cubic feet per second (cfs)
$A$ = Cross Sectional Flow Area ($ft^2$)
$R_h$ = Hydraulic Radius (ft)
$= A/P_w$
$P_w$ = Wetted Perimeter (ft)
$S$ = Slope (ft/ft)
$n$ = Manning's roughness coefficient for open channel flow

The flow discharge rate as determined in Equation (1) is 82.8 cfs. Using Manning's equation, a flow discharge rate is calculated based on a given water depth using Equation (2). The flow discharge rate is then compared to the capacity to determine if the assumed water depth is conservative.

Start with an assumed water depth of 4 inches. The 400 foot bottom width is the width at the bottom of slope where the flow would be coming off the Fermi 3 elevated area.

$A = 400\text{ft} * 0.33\text{ft} = 132\ \text{ft}^2$
$P_w = 400 + 0.33 + 0.33 = 400.66$ ft
$R_h = 132/400.66 = 0.33$ ft
$S = 1/1000$ ft $= .001$
$n = 0.025$ (for gravelly earth)

Thus, the flow discharge rate is: $Q = 119.3$ cfs.

At 4 inches the flow capacity exceeds the discharge rate. Thus, the water depth will be less than 4 inches. With a site elevation of approximately 582.7 feet at the start of the flow path, an additional 4 inches will result in a water level slightly less than 583.03 feet. In this case, as the flow continues downstream, the available area for water flow will increase, resulting in an expected decrease in the water level. Therefore this is a limiting water depth.

Conservatively accounting for the additional water discharge from the Fermi 3 raised area, it would still be expected that the water under PMP conditions would drain overland prior to reaching the base of door sills on safety-related structures. As stated in the Fermi 2 UFSAR, Section 2.4.2.3, the door sills are at least 6 inches above Fermi 2 plant grade. It should also be noted that the flow from the excess area will not affect the safety-related structures because the flow path is along a road that runs northwest until it reaches the north canal. This is away from the Fermi 2 safety-related structures.

Therefore, surface runoff from Fermi 3 will not adversely impact Fermi 2 under the worst case scenario (PMP and all storm drained blocked).

**Proposed COLA Revision**

None required

**NRC Additional Draft RAI Related to FSAR Section 10.4.5. (eRAI 3823)**
*Additional details regarding Fermi 3 site grading and drainage systems to ensure that the discharge water due to a failure of the tower or the CWS piping does not effect the safety-related systems or equipment that are located in the SC I and SC II structures.*

**Full Text (supporting information)**

*In the Fermi 3 combined license (COL) application, FSAR Section 10.4.5.2.1, "General Description," Detroit Edison (the applicant) described that its circulating water system (CWS) consists of one natural draft cooling tower (NDCT). Also, in FSAR Section 10.4.5.8, "Normal Power Heat Sink," the applicant described that the site-specific NDCT is located at least a distance equal to its height away from Seismic Category (SC) I and II structures. Therefore, any structure failure of the cooling tower would not affect or damage safety-related structures, systems, or components (SSCs). Further, in its FSAR Revision 1 mark-ups, the applicant described that the NDCT is relocated and is much closer to the Fermi 3 power block structures than the previous location. Additionally, a new Section 10.4.5.6, "Flood Protection," has been added to Revision 1, where the applicant provided few details regarding the site grading and stated that the NDCT is located lower than the power block structures. Therefore, the applicant stated that there are no potential flooding concerns to the power block structures from a failure in the CWS (including the NDCT basin) in the yard.*

*According to the Standard Review Plan (SRP), Section 10.4.5, "Circulating Water System," SRP Acceptance Criteria, the requirements of General Design Criteria 4 (GDC 4) are met when the CWS design includes provisions to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. The NRC staff reviewed the information provided by the applicant in Revision 0 and Revision 1 (mark-up) of the FSAR. The staff also reviewed the GDC 4 and the SRP guidance with respect to flooding due to failure of the CWS structures or components. Failure of the cooling tower or CWS piping (including the yard piping) could be potential sources for flooding. Therefore, the staff requests that the applicant provide additional details regarding Fermi 3 site grading and drainage systems to ensure that the discharge water due to a failure of the tower or the CWS piping not effect the safety-related systems or equipment that are located in the SC I and SC II structures.*

**Response**

Failure of a pipe or component in the natural draft cooling tower (NDCT), or elsewhere in the Circulating Water System (CIRC), would not have an adverse impact on the design functions of safety-related SSCs.

For the NDCT, the largest components are the CIRC discharge piping. The four CIRC pumps are arranged in parallel, and the discharge lines combine into two parallel main circulating water supply lines to the main condenser. A pipe break in the combined line would be a limiting pipe break scenario.

The CIRC pipes, for the most part, are routed below grade. However, the pump discharge may be located above grade prior to running below grade. A postulated rupture of one of the CIRC pipes above grade would result in water flow in the area of the yard near the natural draft cooling tower (NDCT).

Figure 3 (attached) shows the flow paths in the yard and the vicinity of the NDCT based on the slope of existing grading. Proposed grading in this area will follow the existing grading to the extent practical as shown on Figure 3. The yard area east and south of the NDCT slopes to the south, and the yard area west and north of the NDCT slope to the west. The Fermi 3 power block area is elevated to 589.3 NAVD 88 as indicated in FSAR Section 2.4.10 which is above the elevation west of the NDCT, south lagoon area, and north area leading to the north lagoon. Water discharged from the postulated break in the CIRC line above grade would initially flow west away from Fermi 3. If the water began to pool, water would flow north and south to the north and south lagoons. Therefore, safety-related SSCs would not be subjected to flooding as a result of a failure of the largest NDCT component.

The failure of this CIRC piping bounds other failures of piping and components in the CIRC. The remainder of the CIRC system is either underground or has smaller diameter piping. Failures of these underground and smaller diameter components would have lower flow rates than a postulated failure of the above ground, large-bore CIRC pipe. Additionally, flow from such a failure would flow away from any safety-related structures and not cause any flooding to these structures.

Failure of the NDCT basin has also been considered. Because the basin is an in-ground structure, the maximum water level elevation in the basin is lower than the elevations of the surrounding areas. This design and the selected location ensure that failure of the basin results in no water discharge to the surface. A collapse of the NDCT could impact the integrity of the basin structure. Given that the basin is located below grade elevation at the tower and the grade elevation at the tower is less than the grade elevation for the safety related structures, this failure would not result in flooding of the safety related structures. A collapse of the NDCT could also displace the water in the basin. In this case, assuming that the water in the basin was completely displaced, the water would be released at the grade elevation for the NDCT. As discussed above, the grade elevation for the NDCT is lower than the grade elevation of the power block area. In this event, the flow paths would be similar to that shown on Figure 3 and would not impact the power block area. Therefore, no safety-related structures would be affected by a failure in the basin or NDCT.

**Proposed COLA Revision**

None required

**Figures for Attachment 2**

**Figure 1 (Existing Drainage Basin Assuming All Drains Clogged)**
**Figure 2 (Excess Area Draining Towards Fermi 2 Under Developed Conditions)**
**Figure 3 (Cooling Tower Basins)**

**(following 3 pages)**

FIGURE 1
EXISTING DRAINAGE BASINS
ASSUMING ALL DRAINS CLOGGED

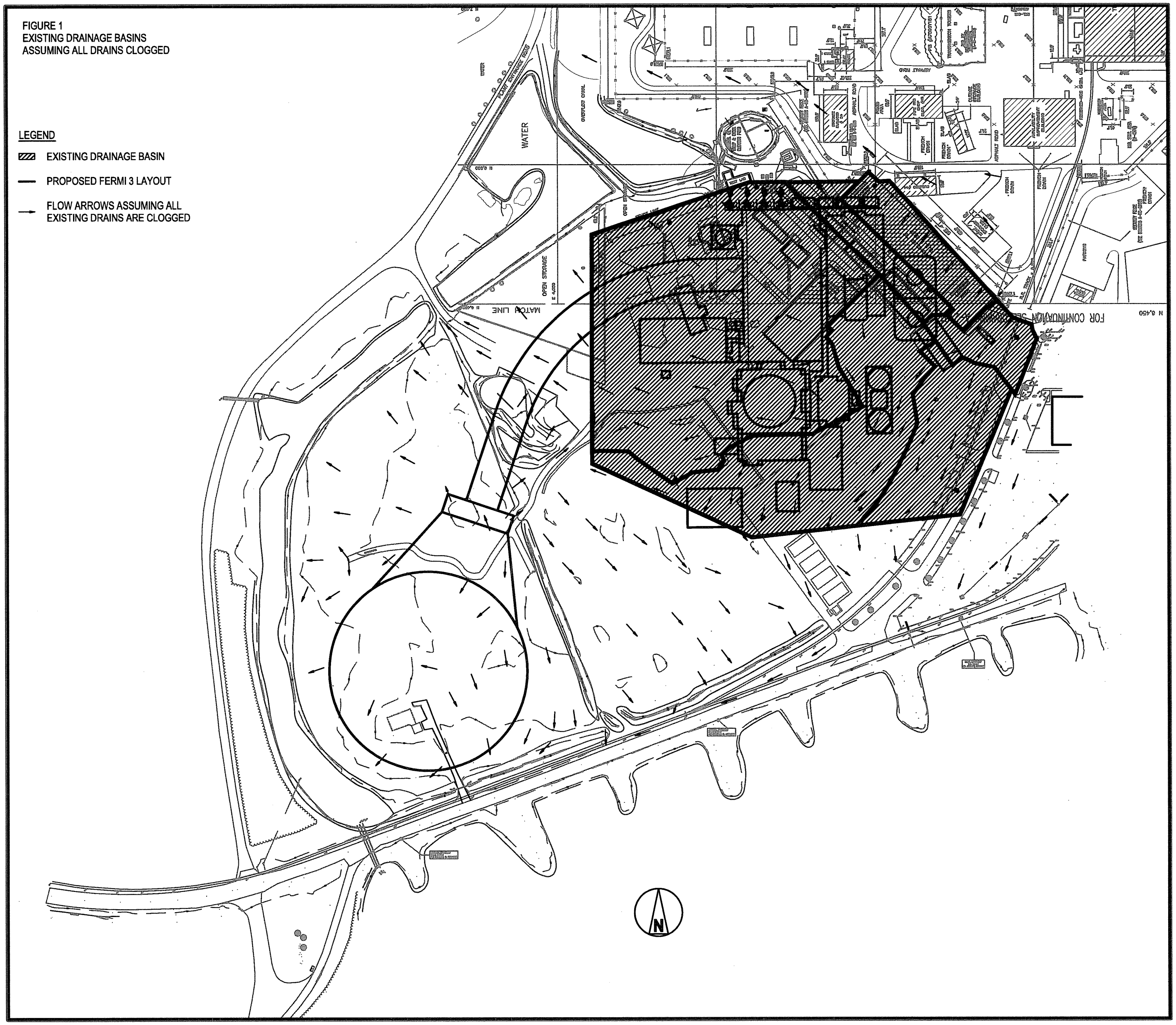


FIGURE 2
EXCESS AREA DRAINING TOWARDS
FERMI 2 UNDER DEVELOPED CONDITIONS

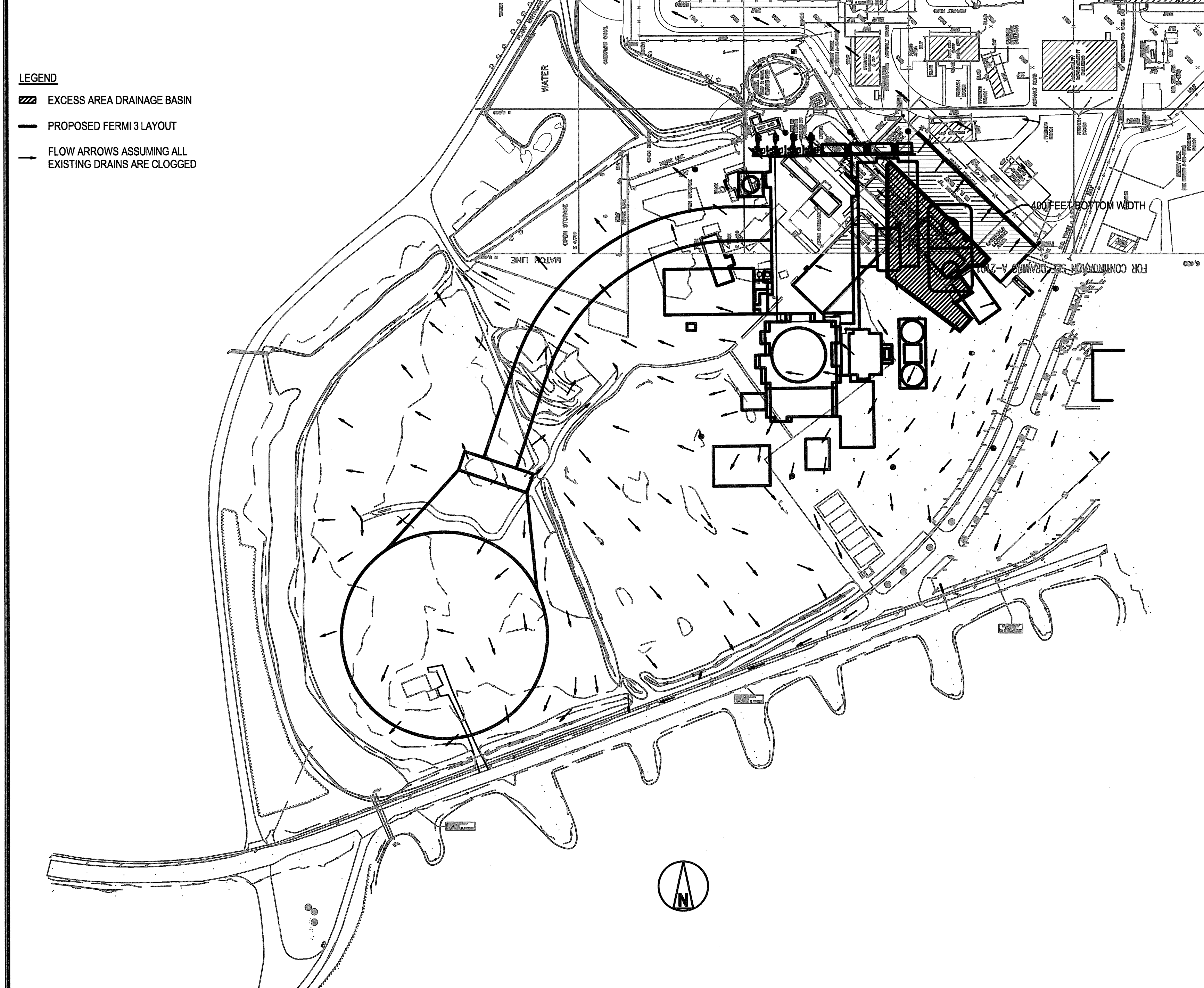


FIGURE 3
COOLING TOWER BASINS

**Attachment 3**
**NRC3-09-0035**

**Response to RAI Letter No. 15**
**(eRAI Tracking No.3778)**

**RAI Question No. 02.04-13-8**

**NRC RAI 02.04-13-8**

*To meet the requirements of 10 CFR 20, Appendix B which requires that radionuclides released in liquid effluents do not result in concentrations at the nearest source of potable water that exceed the concentrations listed in Table 2, Column 2, and to support the staff's review of the application, please provide information on the construction plans for the circulating water system pipes linking the new cooling tower location to the nuclear island. If below ground, provide their construction details and a map showing pipe size, depth, and backfill materials, etc., and provide an assessment on if the new additions have any impact on accidental release analysis discussed in 2.4.13.*

**Response**

The path of the Circulating Water System (CIRC) pipes from the cooling tower to the turbine island are shown on the updated figures provided in Detroit Edison letter NRC3-09-0020, dated August 26, 2009 (ML0924050482). The pipes will be located below ground, but will not impact the accident release analysis discussed in FSAR Section 2.4.13.

For the analysis discussed in FSAR Section 2.4.13.1.2, the release point is at the lowest elevation of the Radwaste Building. This is approximately 540 ft NAVD88. The grade level of the Radwaste Building is 589.3 ft NAVD88 as shown on FSAR Figure 2.5.4-204. The CIRC pipes are expected to be 11 feet in diameter, buried 6 feet below the grade level to support heavy haul loads, and typically have 6 inches of bedding below the bottom of the pipe. Using these values, the total depth of the piping is 17.5 feet. The lowest elevation of the CIRC piping trench will be at the lowest plant grade level it is buried at. The lowest plant grade level for the CIRC pipe trench is between the cooling tower and the elevated power block area. The grade elevation between the cooling tower and where the elevated power block area containing the Radwaste Building will be located is approximately 583 ft NAVD88 as shown on FSAR Figure 2.4-215. Using a depth of 17.5 feet, the CIRC pipe trench is at an elevation of approximately 565.5 ft NAVD88; which is 25.5 feet above the release point for the accident analysis.

FSAR Section 2.4.12.2.3.2.4 indicates that the vertical component of groundwater flow is predominantly downward from the overburden to the Bass Islands Group, and that flow within the Bass Islands Group is downward towards the Salina Group. Therefore, as the predominant vertical direction of groundwater flow on the site is downward, the flow would not be up in the direction of the CIRC piping trench from the release.

FSAR Figures 2.5.1-236, 2.5.1-238, 2.5.1-239, 2.5.4-201, 2.5.4-203, and 2.5.4-204 provide cross sectional views of the site showing the geological profile in the area of Fermi 3. As shown on these figures, the CIRC piping trench depth of 565.5 ft NAVD88 is in the overburden glacial till layers, and the Radwaste Building accident release point depth of 540 ft NAVD88 is in the Bass Islands Group. The glacial till in the overburden layer will impede flow from the Bass Islands Group to the CIRC piping locations in the overburden glacial till layers.

Thus, because the vertical direction of flow from the overburden glacial till layers to the Bass Islands Group is downward, and the glacial till layers will impede flow from the Bass Islands Group to the overburden, items located in, or above, the glacial till layers in the overburden would not impact the groundwater flow in the Bass Islands Group. Therefore, because the CIRC pipes are located in the glacial till overburden layer above the release point located in the Bass Islands Group, the CIRC pipes will not impact the analysis.

**Proposed COLA Revision**

None required

**Attachment 4**
**NRC3-09-0035**

**Response to RAI Letter No. 15**
**(eRAI Tracking No. 3779)**

**RAI Question No. 02.04.05-2**

**NRC RAI 02.04.05-2**

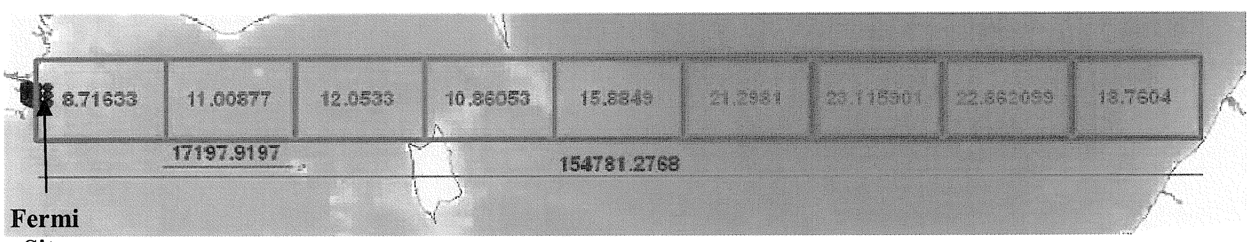
*To meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100, and to support the staff's review of the application, estimates of the probable maximum storm surge are needed. Please provide a plan-view figure detailing the spatially distributed results of the STWAVE simulation from which the storm surge height of 3.14 m (10.3 ft) was derived. On the new figure, please note the locations of Fermi 3 and the point/model cell chosen to determine the storm surge height presented in the text.*

**Response**

Storm surge was not calculated using the STWAVE model. The STWAVE model was used to calculate wave heights in Lake Erie associated with 100 mph winds. The Bretschneider method was used to calculate storm surge (FSAR Ref 2.4-257). Using this method storm surge or wind setup is a function of wind speed, fetch and water depth. The Bretschneider method includes a procedure to account for an irregular lake bottom, which was used in the analysis. The Bretschneider method uses straight line fetches across an enclosed water body. A transect that represented the longest straight line across the lake that ended at the Fermi site was used in the analysis. It was assumed that the calculated storm surge applied to all points along the shoreline at the Fermi site.

Figure 1 below indicates the straight line transect used in the calculations and the depths for each segment. The Fermi site is depicted on Figure 1, depths are the average value in feet above the 100 year lake level.

**Figure 1.**
**Transect Used in Bretschneider Method**




**(Numbers in the boxes are average depths in feet above the 100 year lake level. The length of each segment is 17197.9197 feet, and the total of all segments is 154781.2768 feet.)**

**Proposed COLA Revision**

None required

**Attachment 5**
**NRC3-09-0035**

**Response to RAI Letter No. 15**
**(eRAI Tracking No.3779)**

**RAI Question No. 02.04.05-3**

**NRC RAI 02.04.05-3**

*To meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100, and to support the staff's review of the application, an estimate of wind-induced wave runup under Probable Maximum Storm winds is needed. ANSI-ANS-2.8-1992 section 7.4 requires this analysis "to determine the maximum flood at the site." The criteria and methods of the USACE, as generally summarized in USACE Coastal Engineering Manual, are used as a standard to evaluate the estimate of coincident wind-generated wave action and runup. These criteria are also used to evaluate flooding, including the static and dynamic effects of broken, breaking, and non-breaking waves.*

*(1) Please provide a quantitative basis for the following statement in section 2.4.5.3.2.4 "The analysis of wave run-up determined that waves could not directly impact Fermi 3." Describe the elevation at which waves will break along the entire Fermi site when coincidental with a storm surge and independently thereof.*

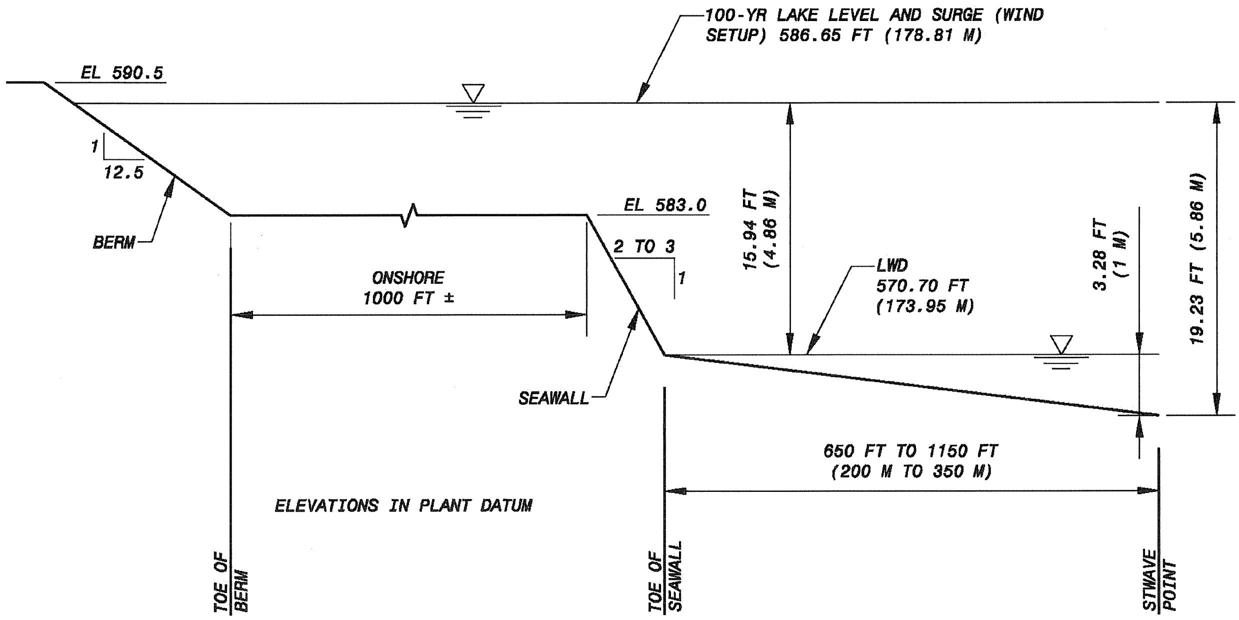
*(2) Please provide a plan-view figure detailing the spatially distributed results of the STWAVE simulation from which the wave height of 3.92 (12.86 ft) was derived. On the figure, note the locations of Fermi 3 and the points that were chosen to determine the highest waves generated.*

**Response**

The statement "The analysis of wave runup determined that waves could not directly impact Fermi 3," was a conclusion based on the results of the wave runup analysis. FSAR Section 2.4.5.3.2.3 discusses breaking wave characteristics. FSAR Table 2.4-224 listed wave heights after breaking at two points, the toe of the seawall and the toe of the berm. This analysis was completed for the case of the 100 year lake level in combination with the storm surge.

The following figure presents a cross section showing a transect between the Fermi 3 site to the grid point. Ground elevations and the still water surface water elevation are shown using the Fermi Plant Datum (PD). The water depths are from Mean Low Water (MLW). The areas shown on the figure can be described as:

- Nearshore – the area from 3.3 ft depth (MLW) to 0 ft depth (MLW). This area is between the points used to describe the waves at the shore (from STWAVE model) to the base of the seawall. The area is about 650 ft (200 m) to 1,150 ft(350 m) wide with a slope of about 200H: 1V.
- Seawall – the area of onshore protection from an elevation of 570.7 ft (173.95 m) to 583 ft (177.7 m) with a slope of 3H: 1V to 2H: 1V.
- Onshore - the area immediately behind the seawall. This area is approximately flat with a width of about 1,000 ft.
- Berm – area between the onshore flat area and the project site. This area has a slope of about 12.5H:1V with smooth slopes. Although there is a flat area within this area it ends at an elevation of 590.5 ft.




The steps used to calculate the wave runup were discussed in Section 2.4.5.3.2 and included:

1. Selected wave height and period based on STWAVE results ($H_{mo}$ = 3.77 m, $T_p$ = 11.1 sec)
2. Simulated wave transmission across the nearshore area.
3. Calculated breaking wave characteristics (wave length and height) at two locations – the toe of the sea wall (H = 2.89 m) and the toe of the berm (H = 0.68 m).
4. Calculated the wave runup on the berm using the wave characteristics for the toe of the berm and structure height and water depth shown on the attached figure.

Wave runup was calculated to be 3.01 ft. This height in addition to the still water elevation of 586.65 (PD) means runup would reach an elevation of 589.66 ft (PD) about 1 ft below the elevation of Fermi 3. The wave runup number calculated by ACES is for the significant wave. The significant wave can be defined as the average of the one-third highest waves. Therefore, the runup value does not consider the effects of larger waves that could be present at the site. To account for the larger waves that could be present at the site an overtopping analysis was conducted. At the elevation of 590.5 (PD), which is the ground elevation of the safety features for Fermi 3, the overtopping rate would be less than 0.004 $ft^3$/lineal ft. This amount represents the amount of water that may splash onto the site from an occasional larger wave.

The above discussion pertained to breaking waves and runup coincident with the storm surge and the 100 year lake levels. Wave runup was not calculated for the case of 100 year lake levels without storm surge because this would result in lower runup values and, thus, was considered to be a much less critical case. However, in response to this RAI additional evaluations were performed.

Without storm surge the 100 year water level would be 576.35 (PD) and the onshore area would not be submerged. Using the same equations presented in Section 2.4.5.3.2.3, the wavelength and breaking wave height at the toe of the seawall would be 45.2 m (148.2 ft) and 1.06 m (3.48 ft), respectively. As in previous calculations it was assumed that the wave period would not change. This is a conservative assumption as it is likely that the period would decrease which would result in less runup.

Additional ACES model runs were then made using the wave characteristics of H = 3.48 ft and T = 11.1 sec. Additional input values included a rip-rap surface with slopes of 2H:1V and 3H:1V. The runups for these two slopes were calculated to be 6.1 ft and 5.3 ft. For these slopes the overtopping rates were calculated to be 0.026 $ft^3$/lineal ft and 0.01 $ft^3$/lineal ft. These results indicate that some water would overtop the seawall on the onshore area but water levels would be well below the Fermi 3 elevation.

STWAVE modeling was conducted for the entire area of Lake Erie using a 100 m grid. The figure below shows the STWAVE grid points in the vicinity of the Fermi site. The red points represent the grid points that are closest to the shoreline in the Fermi area. STWAVE results for these locations were extracted from the model results. The attached table lists the x-y coordinates of the red points and the wave height and period at those locations. Data corresponding to the green points are not shown on the table because they are farther from shore. The green points are shown to indicate the scale of the grid used in the calculations.

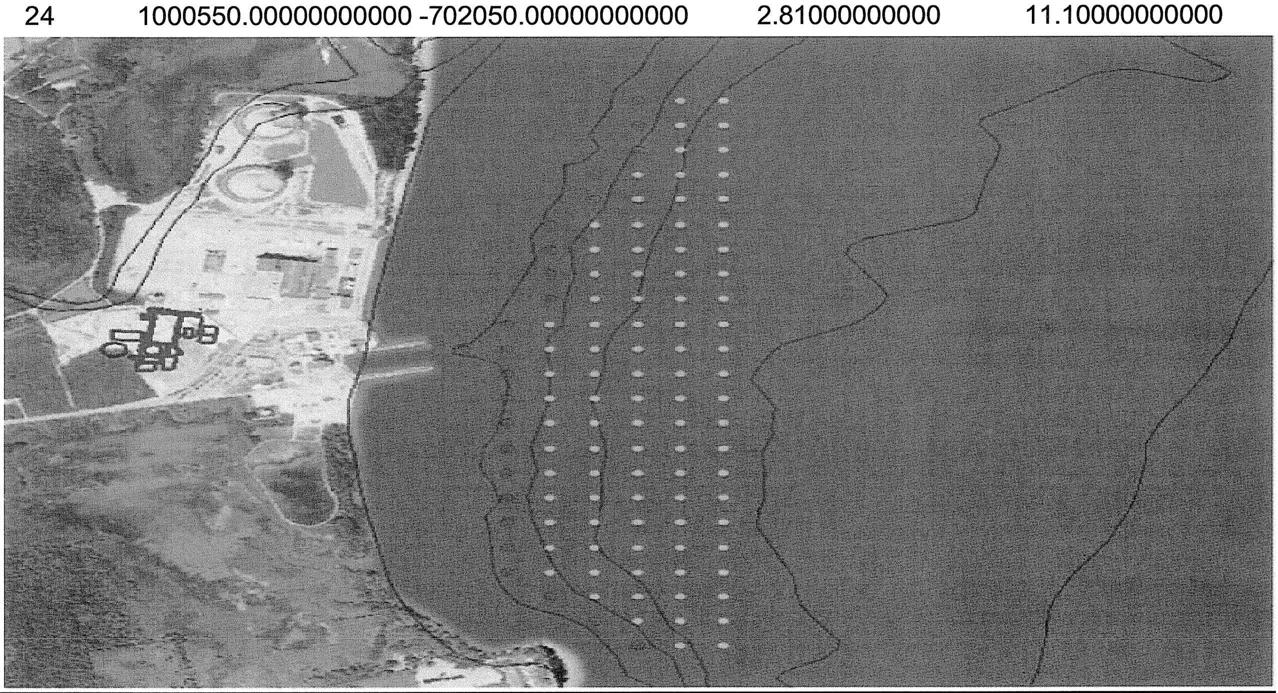
The table is organized first by north-south lines starting from the farthest east moving to the west (from right to left). For each OBJECTID the x and y coordinates are listed. For example, the first 3 points listed on the table correspond to the 3 red dots in a line at the top of the figure (third line from the right). The fourth point is located at the very bottom of the same line. The next three points are on the next line to the west; two at the top and one at the bottom of the line. The last point on the list corresponds to the point farthest to the west and is the only point on that line.

The point closest to the shore (Object ID 24) does not have the highest wave height and was not used in the analysis. In order to be conservative, Object ID 11 (fourth red dot from the top of the fifth line from the right) with a wave height of 3.77 m and wave period of 11.1 sec was used in the analysis. There is only one other point (Object ID 3) with a higher wave height. However, a wave at Object ID 3 would move through Object ID 5 location as the wave moved toward the Fermi 3 site. Thewave height at Object ID 5 is 3.64 meters. Therefore, using the wave height at Object ID 11 is conservative.

The wave height identified at the grid location in the table is not the same wave height that will reach the Fermi 3 site. As waves move onshore they will shoal, break and finally runup the slope of the berm. STWAVE was not used to simulate these effects because according to the User's Manual (FSAR Ref 2.4-251) STWAVE should not be used for steep slopes. For natural shorelines and beaches slopes steeper than 10H:1V are considered to be steep. Some of the areas between the grid point and the Fermi site have slopes of 3 or 2H:1V.

Therefore, as discussed in FSAR Section 2.4.5.3, calculations were made to determine how wave heights would change moving across the nearshore area, the seawall, the onshore area and finally runup on the Fermi 3 site. It should be noted that the grid point is at a depth of 3.28 ft (1 m) MLW and that the onshore area would be submerged if the 100 year lake level was combined with the calculated storm surge. Wave heights, after breaking and before runup were shown on Table 2.4-224.

| OBJECTID | X | Y | HMO_N42 | TP_N42 |
|---|---|---|---|---|
| 1 | 1000950.00000000000 | -701050.00000000000 | 3.60000000000 | 11.10000000000 |
| 2 | 1000950.00000000000 | -701150.00000000000 | 3.75000000000 | 11.10000000000 |
| 3 | 1000950.00000000000 | -701250.00000000000 | 3.91000000000 | 11.10000000000 |
| 4 | 1000950.00000000000 | -703250.00000000000 | 3.64000000000 | 11.10000000000 |
| 5 | 1000850.00000000000 | -701350.00000000000 | 3.64000000000 | 11.10000000000 |
| 6 | 1000850.00000000000 | -701450.00000000000 | 3.74000000000 | 11.10000000000 |
| 7 | 1000850.00000000000 | -703150.00000000000 | 3.05000000000 | 11.10000000000 |
| 8 | 1000750.00000000000 | -701550.00000000000 | 3.46000000000 | 11.10000000000 |
| 9 | 1000750.00000000000 | -701650.00000000000 | 3.53000000000 | 11.10000000000 |
| 10 | 1000750.00000000000 | -701750.00000000000 | 3.61000000000 | 11.10000000000 |
| 11 | 1000750.00000000000 | -701850.00000000000 | 3.77000000000 | 11.10000000000 |
| 12 | 1000750.00000000000 | -703050.00000000000 | 2.94000000000 | 11.10000000000 |
| 13 | 1000650.00000000000 | -701950.00000000000 | 3.47000000000 | 11.10000000000 |
| 14 | 1000650.00000000000 | -702050.00000000000 | 3.45000000000 | 11.10000000000 |
| 15 | 1000650.00000000000 | -702150.00000000000 | 3.45000000000 | 11.10000000000 |
| 16 | 1000650.00000000000 | -702250.00000000000 | 3.45000000000 | 11.10000000000 |
| 17 | 1000650.00000000000 | -702350.00000000000 | 3.28000000000 | 11.10000000000 |
| 18 | 1000650.00000000000 | -702450.00000000000 | 3.58000000000 | 11.10000000000 |
| 19 | 1000650.00000000000 | -702550.00000000000 | 3.53000000000 | 11.10000000000 |
| 20 | 1000650.00000000000 | -702650.00000000000 | 3.45000000000 | 11.10000000000 |
| 21 | 1000650.00000000000 | -702750.00000000000 | 3.54000000000 | 11.10000000000 |
| 22 | 1000650.00000000000 | -702850.00000000000 | 3.50000000000 | 11.10000000000 |
| 23 | 1000650.00000000000 | -702950.00000000000 | 3.25000000000 | 11.10000000000 |
| 24 | 1000550.00000000000 | -702050.00000000000 | 2.81000000000 | 11.10000000000 |



**Proposed COLA Revision**

None required

**Attachment 6**
**NRC3-09-0035**

**Response to RAI Letter No. 15**
**(eRAI Tracking No. 3779)**

**RAI Question No. 02.04.05-4**

**NRC RAI 02.04.05-4**

*To meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100, and to support the staff's review of the application, estimates of seiche and resonance in water bodies induced by meteorological causes, tsunamis, and seismic causes are needed.*

*(1) The applicant stated in FSAR Revision 1, Section 2.4.5.4, Page 2-455: "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) Please provide the quantitative basis and methodology in determining the natural period of oscillation of the flooded area and the incident shallow-water storm waves.*

**Response**

The statement that the period of oscillation of the flooded area was much greater than the period of incoming waves was based on information contained in the USACE Costal Engineering Manual (CEM). According to the CEM, seiche conditions result from changes in atmospheric pressure and resultant wind conditions. The frequency of oscillation is a function of forcing in combination with basin geometry and bathymetry. The CEM (Part II, Chapter 5, Section 5.6) states that

> *Dominant long period seiche conditions on the Great Lakes have resonant modes with period varying from 2 to 12 hours.*

In areas of relatively simple geometry, modes of oscillation can be predicted from the shape of the basin. For an open ended basin, the period (T) can be described by:

$T = 4 * Lb / \{ (1+2n)* (gh)^{1/2}\}$

Where:

Lb = basin length
n = mode of oscillation
g = acceleration due to gravity
h = water depth

For the Western Basin of Lake Erie, Lb is approximately 51,200 m and h is 10.6 m. Using these values, the period of the first six modes would range from 0.4 to 1.9 hours. If the flooded onshore area were considered to be a separate open ended basin, Lb would be about 1000 ft and h would be 3.6 ft. In this case the first six modes of oscillation would range from 29 to 124 seconds. The peak spectral period of the incoming waves is 11.1 seconds, much less than the period of oscillation of the Western Basin and about one-third of the period of oscillation of the flooded area.

**Proposed COLA Revision**

None required