



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

April 12, 2016

Vice President, Operations  
Entergy Nuclear Operations, Inc.  
P.O. Box 110  
Lycoming, NY 13093

**SUBJECT: NUCLEAR REGULATORY COMMISSION REPORT FOR THE AUDIT OF  
ENTERGY NUCLEAR OPERATIONS, INC.'S. FLOOD HAZARD  
REEVALUATION REPORT SUBMITTAL RELATING TO THE NEAR-TERM  
TASK FORCE RECOMMENDATION 2.1-FLOODING FOR JAMES A.  
FITZPATRICK NUCLEAR POWER PLANT (CAC NO. MF6106)**

Dear Sir or Madam:

By letter dated June 1, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15146A282), the U.S. Nuclear Regulatory Commission (NRC) informed you of the staff's plan to conduct a regulatory audit of Entergy Nuclear Operations, Inc.'s (the licensee) Flood Hazard Reevaluation Report (FHRR) for James A. FitzPatrick Nuclear Power Plant (FitzPatrick). The audit was intended to support the NRC staff review of the licensee's FHRR and the subsequent issuance of a staff assessment.

The audit conducted on July 7, 2015, was performed consistent with NRC Office of Nuclear Reactor Regulation, Office Instruction LIC-111, "Regulatory Audits," dated December 29, 2008, (ADAMS Accession No. ML082900195). Therefore, the purpose of this letter is to provide you with the final audit report which summarizes and documents the NRC's regulatory audit of the Fitzpatrick FHRR submittal.

If you have any questions, please contact me at (301) 415-2915 or by e-mail at Victor.Hall@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Victor S. Hall". The signature is written in a cursive style with a large initial "V" and "H".

Victor Hall, Senior Project Manager  
Office of Nuclear Reactor Regulation  
Japan Lessons-Learned Division  
Hazards Management Branch

Docket No. 50-333

Enclosure:  
Audit Report

cc w/encl: Distribution via Listserv



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

NUCLEAR REGULATORY COMMISSION AUDIT REPORT  
FOR THE AUDIT OF ENTERGY NUCLEAR OPERATIONS, INC'S.  
FLOOD HAZARD REEVALUATION REPORT SUBMITTALS  
RELATING TO THE NEAR-TERM TASK FORCE RECOMMENDATION 2.1-FLOODING FOR  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT

BACKGROUND AND AUDIT BASIS

By letter dated March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) "Conditions of license" (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons-learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in The Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident. Recommendation 2.1 in that document recommended that the NRC staff issue orders to all licensees to reevaluate seismic and flooding for their sites against current NRC requirements and guidance. Subsequent Staff Requirements Memoranda associated with Commission Papers SECY 11-0124 and SECY-11-0137, instructed the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f).

By letter dated March 12, 2015, Entergy Nuclear Operations, Inc.'s (Entergy, the licensee) submitted its Flood Hazard Reevaluation Reports (FHRRs) for James A. FitzPatrick Nuclear Power Plant (FitzPatrick) (Agencywide Documents Access and Management System Accession No. ML15082A250). The NRC is in the process of reviewing the aforementioned submittal and has completed a regulatory audit of the licensee to better understand the development of the submittal, identify any similarities/differences with past work completed and ultimately aid in its review of the licensee's FHRR. This audit summary is being completed in accordance with the guidance set forth in NRC Office of Nuclear Reactor Regulation, Office Instruction LIC-111, "Regulatory Audits," dated December 29, 2008 (ADAMS Accession No. ML082900195).

AUDIT LOCATION AND DATES

The audit was completed by document review via a webinar session in conjunction with the use of the licensee's established electronic reading room (ERR) and teleconference on July 7, 2015.

Enclosure

AUDIT TEAM

<b>Title</b>	<b>Team Member</b>	<b>Organization</b>
Team Leader, NRR/JLD	Vic Hall	NRC
Technical Monitor	Laura Quinn-Willingham	NRC
Technical Staff	Lyle Hibler	NRC
Technical Division Director	Andy Campbell	NRC
Projects Branch Chief	Mohamed Shams	NRC
NRC Contractor	Eugene Yan	Argonne National Laboratory (ANL)
NRC Contractor	Vinod Maht	ANL
NRC Contractor	John Quinn	ANL

A list of the licensee's participants can be found in Attachment 2.

DOCUMENTS AUDITED

Attachment 1 of this report contains a list which details the documents that were reviewed by the NRC staff, in part or in whole, as part of this audit. The documents were located in an ERR during the NRC staff's review. The documents, or portions thereof, that were used by the NRC staff as part of the technical analysis and/or as reference in the completion of the staff assessment, will be submitted by the licensee and docketed for completeness of information, as necessary. These documents are identified in Table 1.

AUDIT ACTIVITIES

In general, the audit activities consisted mainly of the following actions:

- Review background information on site topography and geographical characteristics of the watershed.
- Review site physical features and plant layout.
- Understand the selection of important assumptions and parameters that would be the basis for evaluating the individual flood causing mechanisms described in the 50.54(f) letter.
- Review model input/output files to computer analyses such as Hydrologic Engineering Center - Hydrologic Modeling System (HEC-HMS) and FLO-2D to have an understanding of how modeling assumptions were programmed and executed.

Table 1 summarizes specific technical topics (and resolution) of important items that were discussed and clarified during the audit. The items discussed in Table 1 may be referenced/mentioned in the staff assessment in more detail.

EXIT MEETING/BRIEFING

On September 4, 2015, the NRC staff closed out the discussion of the technical topics described above.

**Table 1: FitzPatrick Information Needs – Audit/Post-Audit Summary**

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
1	<p><b><u>All Flood Causing Mechanisms – Comparison of Reevaluated Flood Hazard with Current Design Basis</u></b></p> <p><u>Background:</u> The Flood Hazard Reevaluation Report (FHRR) for the James A. FitzPatrick Nuclear Power Plant (FitzPatrick) site provides comparisons of the reevaluated flood hazards with the current licensing basis (CLB) for all flood causing mechanisms for which a CLB had been established. In FHRR Section 4.1 of the report is a summary of this comparison. The 50.54(f) letter requested a comparison with the current design-basis.</p> <p><u>Request:</u> The licensee is requested to provide clarification regarding the inconsistencies identified in the FHRR with regard to the comparison of the reevaluated flood hazard to the current design basis and submit a revised hazard comparison consistent with the instructions provided in the 50.54(f) letter.</p>	<p>In response to this information need the licensee stated that for the purposes of the FitzPatrick FHRR, the two terms, design-basis and licensing basis, can be considered to have the same meaning. The licensee provided in the electronic reading room (ERR) an amended FHRR Table 4-1. The amended table headings refer to “design-basis flood height” rather than “CLB Flood Height”. The amended table explicitly states the combined effect design-basis flood heights associated with “PMSS [probable maximum storm surge] +PMP [probable maximum precipitation] +Waves” and “Screenwell PMSS+PMP” are “262 ft USLS35 (Design-Basis Flood Level)” and “255 ft USLS35 (Design-Basis Flood Level)” respectively.</p> <p>The U.S. Nuclear Regulatory Commission (NRC) staff concluded that the information provided by the licensee was sufficient to address the information need request.</p> <p>The NRC staff has requested that this information be provided on the docket for their use in the development of the FitzPatrick staff assessment.</p>
2	<p><b><u>All Flood Causing Mechanisms – Location of Site Features</u></b></p> <p><u>Background:</u> The FHRR for the FitzPatrick site includes a site layout (Figure 2-2) that shows some of the site locations that are mentioned but lacks annotations or figures that show all of the site locations that are referred to in the FHRR.</p> <p><u>Request:</u> The figure should be modified or additional similar figures provided that show all of the site feature locations</p>	<p>In response to this information need, the licensee included in the ERR an annotated figure (Figure 2.1) with all the drainage, storm drainage, and requested building locations requested in the information need.</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p>

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
	<p>culverts, drainage ditches and storm drains (including those treated as non-functional), the Interim Waste Storage Facility Building, and the Main Parking Lot.</p>	<p>The NRC staff has requested that this information be provided on the docket for their use in the development of the FitzPatrick staff assessment.</p>
<p>3</p>	<p><b><u>Local Intense Precipitation</u></b></p> <p><u>Background:</u> Calculation package 32-9227045 includes Table 3 which lists Manning's <math>n</math> values for paved/concrete, grass, trees/brush, and water. In that calculation package, Figure 11 shows the distribution of the <math>n</math> values across the study area, and no areas with an <math>n</math> value associated with grass surfaces are shown. Yet the power block vicinity and other site areas contain many large grassy areas (Figure 10) treated as paved/concrete.</p> <p><u>Request:</u> Examine and verify whether the <math>n</math> values were conservatively assigned over the entire model domain and correct them if needed. If revised or additional modeling is necessary, provide electronic versions of any associated modeling input and output files.</p>	<p>In response to this information need, the licensee explained that Manning's <math>n</math> was adjusted to control stability. The licensee updated the ERR to include an assessment of the model and the basis for making model adjustments to Manning's <math>n</math> to control stability. In its response the licensee stated that portions of the site within the immediate power block were modeled as paved, and was considered a reasonable representation of the power block area based on site observation and available orthoimagery for the following reasons: 1) in past experience with FLO-2D large changes in Manning's <math>n</math> may cause artificial undulations in water surface profiles, 2) the rougher grass areas are not anticipated to affect water surface elevations at the majority of the critical structures, 3) the grassy areas modeled a paved are well-maintained (short grass) and therefore would have Manning's <math>n</math> values for grasses which are close to the upper range of the Manning's <math>n</math> values for paved surfaces and hence the effect would be inappreciable, and 4) while higher (grassy Manning's <math>n</math>) would potentially increase water surface elevations in those grassy areas the increases would diminish rapidly space due to the general openness of these areas.</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p>
<p>4</p>	<p><b><u>Local Intense Precipitation</u></b></p> <p><u>Background:</u> The approach used with FLO-2D did not use the code's area reduction factors (ARF) or width reduction factors (WRF), but instead increased the ground surface elevation of grid cells located at buildings in order to make the buildings serve as obstructions. Flat roofs result in ponding of water and</p>	<p>In response to this information need, the licensee explained the approach for modeling based on model capabilities. The results were described as realistic. The licensee stated that other reasonable approaches would not significantly change the result.</p> <p>The licensee did not assumed water storage on roofs and no roof parapet walls were included in the model to allow water to shed from roofs other than an amount equivalent to 0.05 ft, which is</p>

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
	<p>less conservative results for flood depth along building perimeters.</p> <p><u>Request:</u> Describe how the LiDAR data was used to determine appropriate cell elevations, especially along building edges where a grid cell contains LiDAR points representing both the ground and the building. Provide justification that the local intense precipitation (LIP) analysis using water storage on the structures with a flat rooftop is a conservative approach. The justification should include a sensitivity analysis using ARF and WRF to remove water storage from grid cells covered by building structures entirely or partially and routing water to the grid next to building grid cells. If revised or additional modeling is necessary, provide electronic versions of any associated modeling input and output files.</p>	<p>consistent with that allowed for the entire model domain. The licensee verified that at the end of the simulations the depth of water stored on the roofs was the 0.05 ft as expected. The licensee described the rationale for their approach for modeling roof drainage rather than the use of ARF and WRFs. The licensee described their justification for not conducting sensitivity analyses based on ARF and WRFs, which was based on the FLO-2D capabilities at the time that the flood reevaluation was being completed. In the licensee's response, their approach was qualitatively compared with that of newer versions of FLO-2D with respect to roof drainage and found the approach used in the reevaluation was consistent with the updated FLO-2D approach.</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p>
<p>5</p>	<p><b><u>Stream and River Flooding</u></b></p> <p><u>Background:</u> The Licensee used FLO-2D to simulate water depth due to stream flooding. Calculation package 32-9227045 includes Table 3 which lists Manning's <i>n</i> values for paved/concrete, grass, trees/brush, and water. In that calculation package, Figure 11 shows the distribution of the <i>n</i> values across the study area, and no areas with an <i>n</i> value associated with grass surfaces are shown. Yet the power block vicinity and other site areas contain many large grassy areas (Figure 10) treated as paved/concrete.</p> <p><u>Request:</u> Examine and verify whether the <i>n</i> values were conservatively assigned in the model and correct them if needed. If revised or additional modeling is necessary, provide electronic versions of any associated modeling input and output files.</p>	<p>In response to this information need, the licensee stated that the same FLO-2D model was used to estimate flooding from the 72-hour duration flooding (caused by the overflow from the local stream during a PMF) and the short duration 6-hour PMP, which encompasses the 1-hour LIP (flooding caused by rainfall directly on the site areas), as discussed in Section 2.2 of the Local Intense Precipitation Calculation (Calculation No. 32-9227045-000). This calculation package is discussed in further detail in response to Information Need No. 3.</p> <p>It is noted however, the flow generated by the PMF is generally flowing away from the small unnamed stream (i.e., the source of the flooding) and toward the power block structures. Additionally, there is no runoff from rooftops during the 72-hour PMF (rainfall was not modeled) which could potentially increase the water surface elevation if backwater effects were anticipated to occur due the grassed areas. Therefore, the conceptual issue of small grassed areas with higher Manning's value prevented flow away</p>

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
		<p>from critical locations and potentially increasing the water surface elevation is not pertinent to the PMF flood mechanism.</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p>
<p><b>6</b></p>	<p><b><u>Stream and River Flooding</u></b></p> <p><u>Background:</u> The Licensee used FLO-2D to simulate water depth due to stream flooding. The approach used with FLO-2D did not use the code's ARF or WRF, but instead increased the ground surface elevation of grid cells located at buildings in order to make the buildings serve as obstructions. Flat roofs result in ponding of water and less conservative results for flood depth along building perimeters.</p> <p><u>Request:</u> Describe how the LiDAR data was used to determine appropriate cell elevations, especially along building edges where a grid cell contains LiDAR points representing both the ground and the building. Provide justification that the LIP analysis using water storage on the structures with a flat rooftop is a conservative approach. The justification should include a sensitivity analysis using ARF and WRF to remove water storage from grid cells covered by building structures entirely or partially and routing water to the grid cells next to building grid cells. If revised or additional modeling is necessary, provide electronic versions of any associated modeling input and output files.</p>	<p>In response to this information need the licensee explained that this was less of an issue for Stream and River Flooding analyses than for LIP because this application of FLO-2D did not include precipitation draining onto site roofs. The licensee's refers to the response to Information Need No. 4 to explain their use of elevation data to configure the FLO-2D site model. However, the licensee noted that no direct precipitation was used in the FLO-2D model; rather, the HEC-HMS model was used to provide precipitation-induced flow from the upper watershed to the FLO-2D model and, therefore, roof drainage calculations were not included for the flood analysis for the flood-causing mechanism.</p> <p>The licensee explained that the possibility of water storage on the rooftops (which is restricted when assigning a completely blocked cell with FLO-2D's area reduction factors) was reassured to be minimal as the storage depth was specifically set to 0.05 ft. The licensee explained that impact from this minimal storage would be insignificant, especially when compared to the conservative nature of not modeling the parapets. In the response for the audit, the licensee created an analysis comparing the two methods for modeling structures within the FLO-2D model and provided technical evidence that the difference in calculation methods is negligible. It was also confirmed in the audit that manual adjustments and inspections were done by the licensee to ensure that there was no incorrect interpolation in cell elevation rendering between building cells and ground elevation cells.</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p>



INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
7	<p><b><u>Combined Effects</u></b></p> <p><u>Background:</u> The FitzPatrick FHRR, Section 3.9.2.1, contains a figure reference (Figure 3-45) to support the conclusion that the backwater from the maximum Lake Ontario storm surge is limited within the unnamed stream and does not affect PMF hazards.</p> <p><u>Request:</u> The licensee is requested to provide a clearer support for this conclusion using a revised figure or a more detailed narrative.</p>	<p>In response to this information need, the Licensee provided in the ERR a detailed discussion to support the conclusion regarding the extent that the Lake Ontario surge backwater effects landward and upstream of the mouth of the unnamed stream. The response included a figure of the FLO-2D results in the vicinity of the unnamed stream mouth and another figure showing the bed elevation profile of the stream with a depiction of the lake water surface elevation. The discussion and the figures adequately support the licensee's evaluation of the insignificance of the backwater effect on the flood hazard evaluation. The response stated that there is an area of high ground approximately 60 feet upstream of Lake Ontario within the stream. The PMSS plus wave set up elevation is 253.9 feet NAVD88 and the high areas is approximately elevation 255.7 feet NAVD88. This flood elevations during the combined events would not be expected to be higher than those computed.</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p>
8	<p><b><u>Flood Event Duration Parameters</u></b></p> <p><u>Background:</u> The March 12, 2012, 50.54(f) letter, Enclosure 2, requests the licensee to perform an Integrated Assessment of the plant's response to the reevaluated hazard if the reevaluated flood hazard is not bounded by the current design basis. Flood scenario parameters from the flood hazard reevaluation serve as the input to the Integrated Assessment. To support efficient and effective evaluations under the Integrated Assessment, staff will review flood scenario parameters as part of the flood hazard reevaluation and document results of the review as part of the staff assessment of the flood hazard reevaluation. The FHRR does provide flood duration parameters in FHRR Table 4-2 and Table 4-4 but some</p>	<p>In response to this information need the FitzPatrick FHRR Tables 4-2 and 4-4 were updated in the ERR. The licensee made the following statement in their response:</p> <ul style="list-style-type: none"> <li>• Warning time information for the two flood mechanisms was not developed to support the FHRR. Significant plant preparation for the beyond design basis flood events postulated in the FHRR is not credited or deemed necessary at FitzPatrick. The only plant action assumed in the FHRR was a procedure to close the exterior doors during periods of intense precipitation, which is not predicated on significant advance warning.</li> <li>• During plant operation, only two exterior entrances are potentially left open unattended. Door C from the FHRR is a roll-up door to the Screenwell Building which may be left</li> </ul>

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
	<p>parameters (warning time, period of site preparation and period of recession) are lacking.</p> <p><u>Request:</u> The licensee is requested to provide the applicable flood event duration parameters (see definition and Figure 6 of the Guidance for Performing an Integrated Assessment, JLD-ISG-2012-05) associated with mechanisms that trigger an Integrated Assessment using the results of the flood hazard reevaluation. This includes (as applicable) the warning time the site will have to prepare for the event (e.g., the time between notification of an impending flood event and arrival of floodwaters on site) and the period of time the site is inundated for the mechanisms that are not bounded by the current design basis. The licensee is also requested to provide the basis or source of information for the flood event duration, which may include a description of relevant forecasting methods (e.g., products from local, regional, or national weather forecasting centers) and/or timing information derived from the hazard analysis.</p> <p>Because the Integrated Assessment will include LIP, the probable maximum flood (PMF) on the local unnamed stream, the licensee is requested to provide clear information on all flood duration parameters.</p>	<p>open unattended. Water intrusion through this door will not impact any equipment important to safety. The other door potentially left open unattended is Door G, which is a rollup door on the northwest side of the Turbine Building. The door would be closed per the severe weather procedure during a period of intense precipitation (FitzPatrick, 2015). The maximum water level of flooding that could enter this door location is below equipment important to safety.</p> <p>The licensee referenced "FitzPatrick, 2015. Procedure Change Request PCR# 1224 for "Severe Weather" AOP-13, 2015."</p> <p>The NRC staff concluded that the information provided by the licensee was sufficient to address the information need request.</p> <p>The NRC staff has requested that this information be provided on the docket for their use in the development of the FitzPatrick staff assessment.</p>
<p>9</p>	<p><b><u>Flood Height and Associated Effects</u></b></p> <p><u>Background:</u> Flood scenario parameters from the flood hazard reevaluation serve as the input to the Integrated Assessment. To support efficient and effective evaluations under the Integrated Assessment, the staff will review flood scenario parameters as part of the 50.54(f) FHHR and document results of the review as part of the staff's assessment. The March 12, 2012, 50.54(f) letter, Enclosure 2, requests that the licensee perform an Integrated Assessment of the plant's response to the</p>	<p>In response to this information need the licensee provided the following explanations in the ERR:</p> <p><u>Wind Waves and Runup:</u> "Due to limited duration, shallow flood water depths, and limited fetches, no significant wave effects are anticipated to occur on the inundated areas including near the critical structures." And "Wind Wave effects on the unnamed stream water surface elevation are negligible due to the narrow channel and high frictional losses with the restricted fetch." The updated summary FHRR Tables 4-2 and 4-4 for LIP and PMF that</p>

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
	<p>reevaluated hazard if the reevaluated flood hazard is not bounded by the current design basis. Specifically, hydrodynamic loading and sedimentation are not discussed for either LIP or the PMF. The FHRR states that the erosion is not anticipated due to low velocities over paved areas, but it does not discuss the potential for sediment to be transported into paved areas and deposited there. FHRR Tables 4-2 and 4-4 state that "hydrodynamic loading was not evaluated" for both LIP and the PMF.</p> <p><u>Request:</u> The licensee is requested to provide the flood height and associated effects (as defined in Section 9 of JLD-ISG-2012-05) that are not described for the LIP and PMF on the unnamed stream. This includes the following quantified information for each mechanism (as applicable):</p> <ul style="list-style-type: none"> <li>• Wind waves and run up,</li> <li>• Hydrodynamic loading, including debris,</li> <li>• Effects caused by sediment deposition and erosion (e.g., flow velocities, scour),</li> <li>• Concurrent site conditions, including adverse weather,</li> <li>• Groundwater ingress</li> </ul> <p>Provide the analysis used to support the conclusions for associated effects. It is requested that the licensee provide analysis of associated effects for these flood causing mechanisms or a clear statement with justification why these effects are excluded.</p>	<p>were loaded into the ERR state that "Wind/wave interaction was not considered to be a credible mechanism coincident with the LIP [and PMF] event due to site constraints, including shallow depths, obstructed fetches, and frequent barriers to wave formation and action."</p> <p><u>Hydrodynamic loading, including debris:</u> "The maximum hydrostatic lateral force (per linear foot of surface) including the additional equivalent hydrostatic portion attributed to the dynamic effects of moving water acting on the critical door with the largest flood depth is calculated" using methods outlined in <i>Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10, American Society of Civil Engineers.</i></p> <p><u>LIP:</u> The licensee determined the maximum hydrostatic force (including a correction for dynamic effects) to be 16.2 lbs/ft. The maximum hydrostatic pressure was determined to be 69.9 lbs/ft<sup>2</sup>. Regarding the Streams and Rivers PMF, the maximum hydrostatic force (including a correction for dynamic effects), was determined to be 21.0 lbs/ft. The maximum hydrostatic pressure was determined to be 63.6 lbs/ft. The updated summary FHRR Tables 4-2 and 4-4 in the ERR for LIP and PMF states hydrodynamic loading was not formally evaluated as velocities were found to be so low as to create only minimal loading.</p> <p><u>Sediment deposition and erosion:</u> Average velocity were computed using Manning's equation and characterization of a the flow channel with a trapezoidal cross-section, slope of 0.006, and cross-sectional area of 64 ft, hydraulic radius of 2.6 ft, Manning's n of 0.4, yielded a channel velocity of 0.6 ft/s. This characterization was equivalent for both LIP and PMF. After consideration of grain size dependent settling velocities and the computed water speed, only sediment with grain sizes smaller than coarse sand (0.3 ft/s settling velocity). The expected level of transported material was</p>

INFO NEED	INFORMATION NEED DESCRIPTION	ACTION (POST-AUDIT)
		<p>determined to be insufficient to alter flood hazard elevation and the degree of erosion minor related to structures important to safety.</p> <p><u>Groundwater Ingress:</u> The thin layer of till was stated as not being capable of significant storage. Groundwater water is collected in the drain at the base of the Reactor Building and removed by two perimeter drain pumps (one active and one spare) to routing collected water to Lake Ontario. Due to low permeability of the surrounding soils and rock, and the dewatering systems groundwater ingress is consider an insignificant hazard. The updated summary tables (FHRR Table 4-2) for LIP states that "groundwater ingress due to LIP is not considered a significant hazard for the FitzPatrick site."</p> <p>The update summary tables for LIP and PMF state that 1) "warning time information for the two flood hazard mechanisms was not developed to support the FHRR.", 2) "Significant plan preparation for the beyond design basis flood events postulated in the FHRR is not credited or deemed necessary at FitzPatrick."</p> <p>The NRC staff has requested that this information be provided on the docket for their use in the development of the FitzPatrick staff assessment.</p>

**ATTACHMENT 1**  
**FitzPatrick Audit Document List**

1. AREVA. 2014a. James A. Fitzpatrick Flooding Hazard Re-Evaluation Report. Document No. 51-9227066-000. January 30, 2014.
2. AREVA. 2014b. James A. Fitzpatrick Flood Hazard Re-Evaluation - Local Intense Precipitation. Document No. 32-9227045. January 30, 2014.
3. AREVA. 2014c. James A. Fitzpatrick Flooding Hazard Re-Evaluation - Combined Events. Document No. 32-9227062-000 Revision 018. January 30, 2014.

**ATTACHMENT 2**  
**List of Entergy Audit Participants**

<u>Name</u>	<u>Organization</u>
1. Don Bentley	Entergy
2. Al Porch	Entergy
3. Mark Hawes	Entergy
4. Dan Brown	Areva
5. Chad Cox	GZA
6. Christine Stonier	GZA

If you have any questions, please contact me at (301) 415-2915 or by e-mail at Victor.Hall@nrc.gov.

Sincerely,

*/RA/*

Victor Hall, Senior Project Manager  
Office of Nuclear Reactor Regulation  
Japan Lessons-Learned Division  
Hazards Management Branch

Docket No. 50-333

Enclosure:  
Audit Report

cc w/encl: Distribution via Listserv

**DISTRIBUTION:**

PUBLIC	JLD R/F	RidsNRRJLD Resource
TGovan, NRR	LQuinn-Willingham, NRO	RidsNroDsea Resource
RidsNrrDorlLp11-1 Resource	RidsNrrDorl Resource	RidsNrrPMFitzPatrick Resource
RidsRgn1MailCenter Resource	RidsNrrLASLent	RidsOgcMailCenter Resource
RidsOpaMail Resource	RidsAcrsAcnw_MailCtr Resource	CCook, NRO
ARivera-Varona, NRO	KErwin, NRO	ACampbell, NRO
MWillingham, NRO	LHibler, NRO	BHarvey, NRO
MShams, NRR		

ADAMS Accession No.: ML16072A035

\*via email

<b>OFFICE</b>	NRR/JLD/JHMB/PM	NRR/JLD/JHMB/LA	NRO/DSEA/RHM2/TR*	NRO/DSEA/RHM1/TM
<b>NAME</b>	TGovan	SLent	LHibler	LQuinn-Willingham
<b>DATE</b>	03/15/2016	03/14/2016	03/22/2016	03/22/2016
<b>OFFICE</b>	NRO/DSEA/RHM2/BC	NRR/JLD/JHMB/BC	NRR/JLD/JHMB/PM	
<b>NAME</b>	ARivera-Varona	MShams	VHall	
<b>DATE</b>	03/22/2016	03/22/2016	04/12/2016	

OFFICAL RECORD COPY