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November 18, 2019
L-19-266

10 CFR 50.54(f)

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

SUBJECT:
Perry Nuclear Power Plant
Docket No. 50-440, License No. NPF-58
Focused Evaluation Regarding Near-Term Task Force Recommendation 2.1 for Flooding

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a letter titled, "Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 2 of the 10 CFR 50.54(f) letter addresses Near-Term Task Force (NTTF) Recommendation 2.1 for flooding and requires two responses. The first response is for licensees to submit a hazard reevaluation report (HRR) in accordance with the NRC's prioritization plan. As indicated in NRC letter dated March 1, 2013, the NRC staff considers the reevaluated flood hazard to be "beyond the current design/licensing basis of operating plants." By letter dated March 10, 2015, FirstEnergy Nuclear Operating Company (FENOC) submitted the flood HRR for Perry Nuclear Power Plant (PNPP). Additional information was provided by FENOC letters dated December 11, 2015 and March 24, 2016, which also included a revision to the flood HRR.

The second required response from the 10 CFR 50.54(f) letter regarding NTTF Recommendation 2.1 is for licensees to submit an integrated assessment report. By letter dated September 1, 2015, the NRC staff described changes in the NRC's approach to flood hazard reevaluations, including its use in evaluating mitigating strategies for beyond-design-basis external events, and the expected interactions and additional information needed to complete these activities. The NRC staff developed a graded approach for determining the need for, and scope of, plant-specific integrated assessments. One step is to perform a mitigating strategies assessment (MSA).

Guidance for performing MSAs for reevaluated flooding hazards is contained in Appendix G of Nuclear Energy Institute (NEI) 12-06, Revision 2, which was endorsed by the NRC in JLD-ISG-2012-01, Revision 1. FENOC submitted the PNPP MSA for flooding by letter dated July 24, 2017.

Another step in the graded approach is to screen the reevaluated flooding hazards results to determine the need for, and scope of, the integrated assessment. Guidance for performing this screening is contained in NEI 16-05, Revision 1, which was endorsed by the NRC in JLD-ISG-2016-01, Revision 1. Screening results are provided in the form of a focused evaluation (FE) or integrated assessment, depending on the selected path to address each unbounded flood mechanism.

By letter dated December 7, 2018, as supplemented by letter dated March 20, 2019, FENOC requested deferral of the PNPP flooding FE in anticipation of the planned permanent shutdown of PNPP in May 2021. By NRC letter dated May 16, 2019, the NRC staff found the request acceptable and considered the PNPP flooding FE actions deferred until May 31, 2021. By letter dated August 30, 2019, FENOC withdrew the certification of permanent cessation of power operations for PNPP. The NRC staff acknowledged the restart of actions related to beyond-design-basis flooding hazard reevaluations for PNPP in a letter dated September 9, 2019.

With this restart of actions, the screening results for PNPP are provided in the enclosed FE. The unbounded reevaluation flood mechanisms previously submitted in the flood HRR, local intense precipitation (LIP) flood, streams and rivers flooding (SRF), and the probable maximum storm surge (PMSS), do not impact key structures, systems, or components or challenge key safety functions at PNPP after implementation of the planned actions and physical modifications to the site. Based on this focused evaluation, an integrated assessment is not needed. The actions related to the 10 CFR 50.54(f) request for information regarding NTTF Recommendation 2.1 for flooding are now complete for PNPP.

There are no new regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Phil H. Lashley, Acting Manager – Nuclear Licensing and Regulatory Affairs, at 330-315-6808.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 18, 2019.

Sincerely,

Frank R. Payne

Enclosure:
Perry Nuclear Power Plant Flooding Focused Evaluation Summary

cc: Director, Office of Nuclear Reactor Regulation (NRR)
NRC Region III Administrator
NRC Resident Inspector
NRR Project Manager

Enclosure
L-19-266

Perry Nuclear Power Plant Flooding Focused Evaluation Summary
(38 pages follow)

FENOC™
FirstEnergy Nuclear Operating Company

PERRY NUCLEAR POWER PLANT FLOODING FOCUSED EVALUATION SUMMARY

NOVEMBER 2019
LETTER L-19-266
ENCLOSURE

FirstEnergy Nuclear Operating Company
Perry Nuclear Power Plant
10 Center Road
Perry, OH 44081

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PERRY FLOODING FOCUSED EVALUATION SUMMARY

1 EXECUTIVE SUMMARY

The Perry Nuclear Power Plant (PNPP) has reevaluated its flooding hazard in accordance with the Nuclear Regulatory Commission's (NRC) March 12, 2012, 10CFR50.54(f) request for information (RFI, Reference 1). The RFI was issued as part of implementing lessons learned from the Fukushima Dai-ichi accident; specifically, to address Recommendation 2.1 of the NRC's Near-Term Task Force report. This requested information was initially submitted to the NRC in the PNPP Flood Hazard Reevaluation Report, Revision 0, (FHRR, Reference 2) on March 10, 2015. Additional information, including Revision 1 to the PNPP FHRR, was provided by FENOC letters dated December 11, 2015 (Reference 14) and March 24, 2016 (Reference 15).

The review and results of the NRC staff audit of the FHRR (Revision 0 and Revision 1), are documented in "Interim Staff Response to Reevaluated Flood Hazards" letter dated July 25, 2016 (ISR, Reference 10), which includes a summary (Table 2 attached to the letter) of the flood-causing mechanisms to be evaluated in the subsequent reviews (Mitigating Strategies Assessment (MSA) and Focused Evaluation (FE)).

Additional analyses resulted in Revision 2 of the FHRR, which provided new flood hazard data. A revised Table 2 (as referenced above) was previously provided to the NRC as an attachment to the Mitigating Strategies Assessment (Reference 12). Therefore, NRC ISR Table 2 information has been updated, as described in Section 5.0, to reflect the FHRR, Revision 2, results and is included with this report as Attachment A.

There are four mechanisms that were found to exceed the design basis flood values at PNPP. These mechanisms are evaluated in this report as summarized below. For all mechanisms the associated effects and flood event duration parameters were assessed as a part of the Mitigating Strategies Assessment and are also included in this evaluation.

1.1 LOCAL INTENSE PRECIPITATION

Reevaluation of the local intense precipitation (LIP) hazard concluded that the event would generate a water level in the powerblock area that exceeds the current licensing basis and would be above many door thresholds potentially challenging key safety functions. In conjunction with the ongoing design basis reconstitution effort, PNPP is developing a flooding protection scheme utilizing a combination of permanently installed passive protection (in the form of incorporated barriers) and temporary/removable incorporated barriers deployed per operator action. Operator action is initiated on an advanced warning alert from a trigger event alert and/or monitoring threshold alert, based on meteorological forecasting. This FE demonstrates the site response is adequate, pending implementation of site modifications and procedure updates.

The LIP follows Path 2 of NEI 16-05, Revision 1 and utilizes Appendix B and C for guidance on evaluating the site protection features.

1.2 STREAMS AND RIVERS FLOODING

This evaluation concludes that site topography, grading, and an earthen embankment serve as passive flood control features which provide the site with reliable protection against the entire range of streams and rivers flooding (SRF) conditions, including associated effects, with adequate available physical margin (APM). The site does not require any human actions to protect key structures, systems and components (SSCs); consequently, an evaluation of the

overall site response is not necessary. The evaluation for streams and rivers flooding follows Path 2 of NEI 16-05, Revision 1.

1.3 Probable Maximum Storm Surge

The evaluation of the probable maximum storm surge (PMSS) includes both high and low lake water levels. The high level exceeds the design basis by several feet; however, based on the elevations of the site and critical structures, sufficient APM is present due to the topographic nature of the site (passive protection). The evaluation of low water level impacts to the operation of the Emergency Service Water (ESW) Pumps demonstrated that sufficient APM is available for all key SSCs, including the ESW pumps.

The evaluation for PMSS follows Path 2 of NEI 16-05, Revision 1.

1.4 Combined Effects – Storm Surge with Wind Generated Waves

The reevaluated combined effects flooding (CEF) consists of high lake water level with wind wave action. The site is passively protected from the CEF due to the facility being situated atop a bluff overlooking Lake Erie; the bluff provides sufficient APM due to the elevation difference between the site elevation and the CEF elevation. The bluff is also provided with shore protection features as discussed herein. It is concluded that this provides reliable flood protection against the applicable flood parameters and sufficient APM exists such that there is no impact.

The evaluation for CEF follows Path 2 of NEI 16-05, Revision 1.

1.5 Interim Actions and Protection

As identified in Section 1.1 above, future actions are required to fully protect PNPP from the reevaluated LIP hazard. In order to address the interim condition of the site, temporary modifications have been implemented to provide increased protection from a postulated beyond design basis LIP hazard. These changes have been implemented in accordance with PNPP licensee commitments L-19-068-1 and L-19-068-2. The protection features are sized based on analyses of the current “as-found” conditions of the site. Protection features include pre-deployed temporary barriers and stored barriers deployed per procedural guidance. Pre-deployed barriers are in the form of sandbags located along vulnerable lengths of building exteriors (judged to potentially permit gross inleakage) and select plant roll-up doors. Stored barriers in the form of removable stop log barriers and sandbags are used to protect mandoors and roll-up doors potentially impacted by the reevaluated LIP flood hazard. Barrier deployment is initiated based on receipt of a meteorological forecast warning as dictated by plant procedure ONI-ZZZ-1 (Reference 36).

Focused Evaluation Conclusion

This Focused Evaluation concludes there to be sufficient APM for all external flood hazards which exceed the current design and licensing basis for PNPP. This is based on completed site modifications and future modifications deemed necessary within Revision 2 of the PNPP FHRR, as proposed in a forthcoming License Amendment Request and related 10CFR50.12 Exemptions. Interim actions discussed above will remain in place until final actions are implemented. This ensures adequate protection is provided for the reevaluated flood hazards at PNPP.

This Focused Evaluation completes the actions for the Fukushima response related to external flooding required by the 10CFR50.54(f) RFI (Reference 1).

2 BACKGROUND

On March 12, 2012, the NRC issued 10CFR50.54(f) RFI (Reference 1) to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for flooding. The RFI directed licensees, in part, to develop and submit a FHRR to reevaluate the flood hazards for their sites using present-day methods and guidance used for early site permits and combined operating licenses. For PNPP, FHRR Revision 0 was submitted on March 10, 2015 (Reference 2) and Revision 1 was submitted on March 24, 2016 (Reference 15). FHRR Revision 2 was included as an attachment to the Mitigating Strategies Assessment Support Document (Reference 13), which was provided to the NRC during the MSA audit.

Following the Commission's directive to NRC Staff (Reference 4), the NRC issued a letter to the industry (Reference 7) indicating that new guidance is being prepared to replace instructions in the NRC directive and provide a "graded approach to flooding reevaluations" and "more focused evaluations of local intense precipitation and available physical margin in lieu of proceeding to an integrated assessment." NEI prepared the new "External Flooding Assessment Guidelines" in NEI 16-05 (Reference 5), which was endorsed by the NRC in Reference 6. NEI 16-05 indicates that each flood-causing mechanism not bounded by the design basis flood (using only still-water and/or wind-wave runup level) should follow one of the following five assessment paths:

Path 1: Demonstrate the flood mechanism is bounded through improved realism

Path 2: Demonstrate effective flood protection

Path 3: Demonstrate a feasible response to LIP

Path 4: Demonstrate effective mitigation

Path 5: Utilize scenario-based approach

The FHRR report identifies the flood-causing mechanisms considered bounded by the existing design basis flood hazard and those that are not. Flood-causing mechanisms determined as bounded within the FHRR require no further action. Non-bounded flood-causing mechanisms in Paths 1, 2, or 3 would only require a Focused Evaluation (FE) to complete the actions related to external flooding required by the 10CFR50.54(f) RFI. Mechanisms in Paths 4 or 5 require a full Integrated Assessment.

3 REFERENCES

1. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident; dated March 12, 2012 (ML12053A340).
2. FENOC Letter to USNRC, Perry Nuclear Power Plant Unit 1, Flood Hazard Reevaluation Report, Rev 0, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f), Regarding the Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident, dated 3/10/2015 (ML15069A056).
3. NRC Letter, Supplemental Information Related to Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 1, 2013. (ML13044A561)
4. NRC Staff Requirements Memoranda to SR-COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards", dated March 30, 2015 (ML15089A236).
5. Nuclear Energy Institute (NEI), Report NEI 16-05 [Rev 1], External Flooding Assessment Guidelines, dated June 2016 (ML16165A178).
6. U.S. Nuclear Regulatory Commission, JLD-ISG-2016-01, Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation; Focused Evaluation and Integrated Assessment, Revision 0, dated July 11, 2016 (ML16090A140).
7. NRC Letter, Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events, dated September 1, 2015 (ML15174A257).
8. Nuclear Energy Institute (NEI), Report NEI 12-06 [Rev 2], Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, dated December 2015 (MA16005A625).
9. U.S. Nuclear Regulatory Commission, JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events, dated January 22, 2016 (ML15357A163).
10. NRC Letter, Perry Nuclear Power Plant, Unit 1 – Interim Staff Response to Reevaluated Flood Hazards Submitted in Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (CAC Nos. MF6099), dated 7/25/2016 (ML 16202A350; ML 16202A348 with Enclosure ML 16202A417).
11. NRC Letter, Perry Nuclear Power Plant, Unit 1 - Staff Assessment of the Flooding Walkdown Report Supporting Implementation of Near-Term Task Force Recommendation 2.3 Related to the Fukushima Dai-Ichi Nuclear Power Plant Accident, dated 7/1/2014 (ML14141A460).
12. FENOC Letter to USNRC, Perry Nuclear Power Plant, Mitigating Strategies Assessment (MSA) for Flooding, dated July 24, 2017 (ML17205A336).

13. NORM-LP-7321, Rev 0, Perry Nuclear Power Plant Flooding Mitigating Strategy Assessment Support Document.

14. FENOC Letter dated 12/11/2015, Planned Revision of Flood Hazard Reevaluation Report in Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident (ML15345A343)

15. FENOC Letter dated 3/24/2016, Revision of Flood Hazard Reevaluation Report in Response to NRC Request for Information Pursuant to 10CFR50.54(f) Regarding the Flooding Aspects of Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident (ML16084A871).

16. NRC Letter, Perry Nuclear Power Plant, Unit 1 - Staff Assessment and Summary Report for the Audit of the Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (CAC Nos. MF6099), dated 1/24/2018 (ML18002A555).

17. PNPP Calculation 50:62.000, Revision 1, "PNPP Major Stream Rail Modification PMF (Beyond Design Basis)" including Addendum A-01

18. PNPP electronic submittal to NRC, titled "Requests for Additional Information (RAI) and Reponses Regarding the PNPP Mitigating Strategies Assessment," Dated 10/30/17

19. PNPP Calculation 50:66.000, Revision 1, "PNPP Site Modifications Local Intense Precipitation (Beyond Design Basis)"

20. PNPP Calculation 50:33.000, Revision 1, "PNPP Stream Modification PMF (Beyond Design Basis)"

21. PNPP Updated Safety Analysis Report (USAR), Revision 20

22. PNPP Calculation 50:55.000, Revision 1, "PNPP Combined Events"

23. PNPP Calculation 50:73.000, Revision 0, "Design Basis Diversion Stream Probable Maximum Flood (PMF)"

24. PNPP Calculation 50:72.000, Revision 0, "Design Basis Major Stream Probable Maximum Flood (PMF)"

25. PNPP Calculation 50:63.000, Revision 1, "PNPP Major Stream Access Road Modification Probable Maximum Flood (Beyond Design Basis)"

26. PNPP Calculation 50:47.000, Revision 1, "Surge and Seiche Analysis (Beyond Design Basis)"

27. PNPP Drawing 015-0002-00000, Revision F, "Final Plant Layout, Emergency Service Water Pumphouse, Plans and Elevations"

28. Nuclear Energy Institute Position Paper, titled "Warning Time for Local Intense Precipitation Events," Revision 6 dated 4/8/15 (ML15104A159 and ML15104A158)

29. NRC Letter, J. Davis (NRC) to J. Riley (NEI), NRC Endorsement with clarifications of NEI Position Paper, titled "Warning Time for Local Intense Precipitation Events," Letter dated 4/23/15 (ML15110A080)

30. PNPP Condition Report 2017-10103, "Error Identified in Beyond Design Basis Calculation 50:55.000, Rev. 0," dated 10/03/17

31. PNPP Calculation P45-081, Revision 0, "" Evaluation of Net Positive Suction Head (NPSH) and Submergence Requirements for the Emergency Service Water (ESW) System Pumps"

32. PNPP Calculation P45-057, Revision 3, "ESW System Thermal Hydraulic Model"

33. PNPP Drawing 726-0210-00000, Revision M, "Offshore Multiport Intake Structure"

34. PNPP Calculation 50:78.000, Revision 0, "Analysis of Plant Buildings Subject to Flooding Loads"

35. PNPP Technical Assignment File: TAF # 081991 Revision 0, External Flooding Walkdown Records.

36. Procedure ONI-ZZZ-1, Tornado or High Winds.

37. Procedure PAP-0550.3, Procedure Validation.

38. PNPP Calculation 50:66.001, Revision 0, "PNPP Local Intense Precipitation Sensitivity Study (Beyond Design Basis). (Confirmation analysis for calc 50:66.000 (Reference 19) – evaluation of model corrections/ improvements).

39. Drawing 744-0035-00000.

40. Vendor document: Tokheim Flame Arresters 85-2.

41. Drawing 303-0021-00000.

42. Drawing 426-0603-00000.

43. Drawing 426-0312-00000

44. Drawing 426-0313-00000.

45. PNPP Calculation 50:87.000, Revision 0, "PNPP Local Intense Precipitation Study Calculation"

4 TERMS AND DEFINITIONS

AIM – Assumptions, Inputs and Methods

APM – Available Physical Margin

BDB – Beyond Design Basis

CEF - Combined Effect Flood - including Wind Wave Action

CLB – Current Licensing Basis

DB - Design Basis

ESW – Emergency Service Water

ESWPH – Emergency Service Water Pumphouse

FE – Focused Evaluation

FENOC – FirstEnergy Nuclear Operating Company

FHRR – Flood Hazard Reevaluation Report

FLEX – Diverse and flexible coping strategies covered by NRC order EA-12-049

FPCC – Fuel Pool Cooling and Cleanup

HPCS – High Pressure Core Spray

IA – Integrated Assessment

ISR – Interim Staff Response

Key SSC – A System, Structure or Component relied upon to fulfill a Key Safety Function

KSF – Key Safety Function, i.e. core cooling, spent fuel pool cooling, or containment integrity.

LIP – Local Intense Precipitation

LPCI – Low Pressure Coolant Injection

LPCS – Low Pressure Core Spray

MSA – Mitigating Strategies Assessment as described in NEI 12-06 Rev 2, App G

MSFHI – Mitigating Strategies Flood Hazard Information

NEI – Nuclear Energy Institute

NGVD29 PLD – Perry Local Datum – NGVD 29 Data corrected to local monument markers

NRC – Nuclear Regulatory Commission

NTTF – Near Term Task Force commissioned by the NRC to recommend actions following the Fukushima Dai-ichi event

PMP – Probable Maximum Precipitation

PMSS – Probable Maximum Storm Surge

PNPP – Perry Nuclear Power Plant

RCIC – Reactor Core Isolation Cooling

RFI – Request for Information

RHR – Residual Heat Removal

SRF – Streams and Rivers Flooding

USAR – Updated Safety Analysis Report

WSE – Water Surface Elevation

All elevations are in NGVD29 PLD, unless otherwise noted.

5 FLOOD HAZARD PARAMETERS FOR UNBOUNDED MECHANISMS

The NRC has completed the ISR (Reference 10) which contains the Mitigating Strategies Flood Hazard Information (MSFHI) related to the FHRR, Revision 1. In the ISR, the NRC states that the staff has concluded that the licensee's reevaluated flood hazards information is suitable for the assessment of mitigation strategies developed in response to Enforcement Action Order EA-12-049 (i.e., defines the mitigating strategies flood hazard information described in Nuclear Energy Institute (NEI) guidance document NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide) (References 8 and 9) for PNPP. Further, the NRC staff has concluded that the licensee's reevaluated flood hazard information is suitable input for the Focused Evaluation associated with Near-Term Task Force Recommendation 2.1, Flooding. The enclosure to the ISR includes a summary of the current design basis and reevaluated flood hazard parameters. In Table 1 of the enclosure to the ISR, the NRC lists the following flood-causing mechanisms for the design basis flood:

Local Intense Precipitation

Streams and Rivers

Failure of Dams and Onsite Water Control/Storage Structures

Storm Surge

Seiche

Tsunami

Ice Induced Flooding

Channel Migrations/Diversions.

In Table 2 of the enclosure to the ISR, the NRC lists reevaluated flood hazard information for the following flood-causing mechanisms that are not bounded by the design basis hazard flood level:

Local Intense Precipitation (LIP)

Streams and Rivers

Storm Surge

These are the reevaluated non-bounded flood-causing mechanisms for PNPP required to be addressed within this Focused Evaluation using Path 1, Path 2, or Path 3 of Reference 5. Should any of these paths not adequately address the flood hazard, the specific hazard will be evaluated using the full Integrated Assessment process to identify the appropriate path, either Path 4 or Path 5 of Reference 5.

Subsequently, PNPP performed analyses to support a design basis reconstitution effort following the submittal of FHRR, Revision 1. In conjunction with this, additional analyses of portions of the beyond design basis flooding evaluations were completed. The modified flood hazard results were summarized in Revision 2 to the FHRR, attached to the Mitigating Strategies Assessment Support Document (Reference 13) and are used for this Focused Evaluation. Therefore, ISR Table 2 has been updated to reflect the FHRR, Revision 2 results and is included in this evaluation as Attachment A. The differences between Table 2 of the ISR and the FHRR, Revision 2 results in Attachment A of this document are summarized below:

LIP

The ISR reported the LIP maximum water surface elevation as 621.3 ft for the powerblock area. The reevaluated LIP flood hazard increases this to 621.65 ft, as shown in Attachment A. This value represents the WSE at the door location with the least (most negative) margin. The margin value is based on door threshold elevations obtained from survey data and assumes no flood protection features have been deployed/implemented. Margin values such as this are present at a number of plant exterior doors and will be used as input for protection height requirements which will be implemented via future plant modifications are described later in this Focused Evaluation.

PNPP Design Basis Reconstitution

The PNPP design basis reconstitution for flooding was developed simultaneously with the flood hazard reevaluation for the 10CFR50.54(f) response. Based on the design basis probable maximum precipitation (PMP), the effects of the LIP were determined by calculation and provide the high-water surface elevations, as well as other external flooding results generated by the LIP. The controlling flood and associated water levels, which exceed the current licensing basis value of 620.5 ft, are a result of the limitations of the sites surface drainage capabilities during the LIP event. Based on this, flood protection requirements are needed to prevent the high-water surface elevations occurring during the LIP event from impacting any safety-related facilities, systems, and equipment on the site.

To address the external flooding vulnerabilities discussed above, PNPP enlists a flooding protection scheme utilizing a combination of permanently installed passive protection (in the form of incorporated barriers) and temporary/removable incorporated barriers installed per operator action. Operator action is initiated on an advanced time-based warning predicted by a meteorologically forecasted precipitation event. The barriers, whether temporary or permanent, will be designed to withstand the static and dynamic loads resulting from the analyzed flood conditions.

As part of the design basis reconstitution, the Standard Project Flood concept is introduced as the minimum wet weather event to which hardened protection is required for all safety-related structures, systems, and components. The Standard Project Storm (SPS), based on the methodology described by the U.S. Army Corps of Engineers, estimates the most severe flood producing rainfall depth-area-duration relationship and isohyetal pattern of a storm that is considered reasonably characteristic of the Perry Nuclear Power Plant region.

Based on the results of LIP flooding discussed above, PNPP will be protected up to and including the Standard Project Storm (SPS) using passive (permanently installed) flood protection features. For any precipitation event larger than the SPS, including the PMP event, PNPP will utilize temporary flooding protection features, specifically removable flood stop log barriers, which will be stored on site and will be deployed per site operational procedure(s). A License Amendment Request and 10CFR50.12 Exemptions are currently being developed for the reconstituted design basis.

With respect to the 10CFR50.54(f) RFI response, specifically the reevaluated flood hazards for LIP, all modifications performed or planned for flood mitigation envelope both the design basis and beyond design basis high-water surface elevations, as well as other external flooding results. For any precipitation event larger than the SPS, which includes the beyond design basis LIP event, the temporary flooding protection features will be deployed per site operational procedure prior to the event. Thus, the design basis and beyond design basis responses for the LIP hazard will be the same.

Streams and Rivers

There is no change to the reported re-evaluated Major Stream flood hazard elevation. The maximum water surface elevation (WSE) remains 628.5 ft at the Rail Line Bridge location (Reference 17).

The Minor Stream no longer functions as a stream or river due to the installation of a new Diversion Stream which intercepts the previous Minor Stream and its watershed and diverts runoff flow directly to Lake Erie. A portion of the originally engineered Minor Stream remains located between the plant area and the Diversion Stream. This section of the stream no longer functions as a traditional stream. The "Remnant Minor Stream", as it is now properly named, is a drainage swale located entirely within the local intense precipitation (LIP) computational domain. Also, an engineered earthen embankment (termed the Diversion Stream berm) was installed to separate the LIP domain from the Diversion Stream and the original Minor Stream watershed. Based on this, the Diversion Stream flood hazard information is included in Attachment A in lieu of the Minor Stream. There is no change to the reported re-evaluated Diversion Stream flood hazard elevation. The maximum water surface elevation (WSE) remains 629.2 ft (Reference 20).

Storm Surge

The ISR includes the flood hazard information based on the probable maximum storm surge (PMSS), including wind generated wave action. The ISR does not differentiate between elevation and location of the PMSS (stillwater) and the maximum WSE when wave runup contributions are considered. Due to the configuration of the Perry site, the PMSS flood hazard (without wind wave action) has the potential to impact the Emergency Service Water Pumphouse and the Emergency Service Water Pump operation. Therefore, it is important to identify and address the PMSS (without wind wave action) as a standalone flood hazard separate from wave runup. With the intent to improve clarity, Revision 2 of the FHRR divided the information of storm surge into two separate sub-hazards; PMSS and PMSS with wind generated wave action (CEF).

Attachment A provides the PMSS maximum and minimum water surface elevations without wind wave action. This information will be used in the Focused Evaluation to evaluate the effects on the Emergency Service Water Pumphouse and Emergency Service Water Pump operation. The effects of PMSS with the addition of wind wave action is included in Attachment A as combined effects flooding and will be used to evaluate site impact since the results exceed the current licensing basis. During preparation of a response to the staff's request for additional information, an error was identified in the calculation which determined the wave runup effects; the incorrect values were documented in both the ISR and Revision 2 of the FHRR. The corrected value, as provided to the NRC staff via RAI response dated October 30, 2017 (Reference 18) is used within this Focused Evaluation.

Associated Effects & Flood Event Durations

In the ISR, the NRC identified that "Associated Effects" and "Flood Event Durations," which were not reported in the FHRR, were expected to be provided in subsequent flooding evaluations. These parameters have since been provided in the Mitigating Strategies Assessment (Reference 12).

Summary
The following table summarizes how each of the unbounded mechanisms are addressed in this Focused Evaluation:

Table 1 Unbounded Flood Mechanisms

	Flood Mechanism	**Summary of Evaluation** (Based on Flooding Impact Assessment Process Path Determination Table 6-3 in Section 6.3.3 of NEI 16-05)
1	Local Intense Precipitation	The LIP is evaluated using Path 2. As discussed, the flood values used in the evaluation, listed in Attachment A, are modified from the ISR values based on the reanalysis in Calculation 50:66.000, Revision 1 and 50:66.001, Revision 0 (References 19 & 38).
2	Streams and Rivers Flooding	The SRF is evaluated using Path 2. For the Major Stream, the values are the same as the ISR values. The engineered portion of the Minor Stream channel no longer functions as a traditional stream or river. Watershed runoff is diverted by the Diversion Stream and the remnant Minor Stream has been incorporated into the LIP domain. The Diversion Stream has been installed to intercept and replace the Minor Stream. The reanalysis, Calculation 50:33.000 (Reference 20), and modification, ECP 13-0802-001, have been implemented mitigating the flood hazard. The values used were not part of the ISR; however, they are the same as those discussed in the final NRC Staff Assessment.
3	Probable Maximum Storm Surge	The PMSS is evaluated using Path 2. The ISR does not specifically identify the flood parameters for the Lake Erie storm surge which is contained by the bluff along the lakeside of the plant (approximate bluff height is 40 feet). The high and low water levels exceed the design basis and are evaluated using the values stated in the FHRR Revisions 1 and 2. This was not discussed in the ISR nor the Staff Assessment.
4	Combined Effects Flood	The CEF is evaluated using Path 2 and includes the PMSS plus the wind wave action. The flood values used in the evaluation are the same as the ISR values identified as Storm Surge – High Water.

5.1 CHARACTERIZATION OF FLOOD PARAMETERS

The following tables document the parameters and values considered for the flood mechanism evaluations.

Table 2 LIP Flood Mechanism Parameters

Item	Parameter Description	Values/Discussion
1	Max Stillwater Elevation	The WSE in the powerblock area that results in the worst case margin is 621.65 ft (References 19 & 38).
2	Max Wave Run-up Elevation	Due to the short duration, shallow depths, various obstructions and inadequate fetch lengths, there is no wave runup considered during a LIP event. (References 19 & 38)
3	Max Hydrodynamic/Debris Loading	Hydrodynamic and hydrostatic loading was evaluated for the structures and determined to be below design loads. Debris loading on plant structures was considered due to the flood levels in the powerblock area. (Reference 34)
4	Effects of Sediment Deposition/Erosion	The LIP is a short duration, low velocity event. Areas surrounding the power block are predominantly concrete and macadam and not subject to scour. Sediment deposition is not considered credible due to the low velocities and short duration of the event.
5	Other Associated Effects	No other associated effects were identified.
6	Concurrent Site Conditions	As a conservative measure, an inflow to the LIP model domain is included for a postulated Diversion Stream berm failure. Additionally, maximized boundary conditions are conservatively assumed for lake level and Major Stream conditions.
7	Effects on Ground Water	Groundwater effects are not deemed credible due to the generally impermeable materials surrounding the power block and the short duration of the event. Additionally, the Underdrain System is designed to maintain groundwater less than 590 ft under a postulated Circulating Water System pipe break event (Reference 21); the Underdrain System inflow design requirements are judged to grossly bound any potential surface water infiltration.
8	Warning Time	12 hrs (estimated). PNPP will utilize a time-based warning for implementation of LIP-hazard flood barriers. The warning will be developed in accordance with NEI Position Paper NEI 15-05, Reference 28 and Reference 29. Upon receipt of the alert, site procedures will dictate the deployment of temporary flood barriers at locations deemed necessary per the results of References 19 & 38.

Item	Parameter Description	Values/Discussion
9	Period of Site Preparation	12 hrs (estimated). This will provide sufficient time for the onsite personnel to ensure doors/hatches are closed and flood barriers installed to prevent water ingress. The value is estimated and will be validated, as required, as part of the Design Basis reconstitution effort at PNPP.
10	Period of Inundation	1 – 2 hrs (estimated). The total site inundation period in the power block area can occur very rapidly. The timing of when this occurs is dependent on the timing of the peak intensity of the rain event. For example, inundation would be within an hour for the front-loaded event, but several hours later for an end-loaded event.
11	Period of Recession	2 hrs (estimated). The site generally drains rapidly after the LIP event except for several low areas where ponding occurs. The value provided is representative of the typical site recession time following the peak intensity of the LIP event.
12	Plant Mode of Operation	Plant response to a LIP event is not Mode dependent. (Note: The Design Basis reconstitution may result in actions to require plant shutdown under certain storm/rainfall conditions.)
13	Other Factors	No other factors were identified.

Table 3 SRF Flood Mechanism Parameters

Item	Parameter Description	Values/Discussion[1]
1	Max Stillwater Elevation • Major Stream • Minor Stream • Diversion Stream	 628.5 ft (Rail Line Bridge, Reference 17) NA (Remnant Minor Stream incorporated in LIP domain) 629.2 ft (Reference 20)
2	Max Wave Run-up Elevation	The locations of the powerblock area and of the streams preclude any wind generated wave effects on the powerblock area.
3	Max Hydrodynamic/Debris Loading	No site flooding occurs due to SRF, so there are no hydrodynamic debris loading concerns.
4	Effects of Sediment Deposition/Erosion	The Diversion Stream berm failure is assumed to occur during the peak water surface elevation in the Diversion Stream, at a location that maximizes the depth. The resulting failure flow is added to the LIP evaluation. Additionally, a preventative maintenance (PM) plan will be developed to monitor the Diversion Stream berm to ensure that failure mechanisms (including erosion) are controlled.
5	Other Associated Effects	Major Stream flooding causes overtopping of the Site access road resulting in a flooding duration of approximately 2.5 hours (Reference 13).
6	Concurrent Site Conditions	No concurrent site conditions were identified.
7	Effects on Ground Water	There will be no groundwater surcharge effects since no site flooding occurs due to SRF
8	Warning Time	No specific warning time is identified as no actions are required for a SRF response.
9	Period of Site Preparation	No actions are required for SRF response.
10	Period of Inundation	The SRF event does not flood the powerblock area; however, the site access road is affected. Period of inundation is approximately 1 hour (Reference 13).
11	Period of Recession	The period of recession for the flooded site access road is approximately 1.5 hours (Reference 13).
12	Plant Mode of Operation	Plant response to a SRF event is not Mode dependent.
13	Other Factors	No other factors were identified.

Table 4 PMSS Flood Mechanism Parameters

Item	Parameter Description	Values/Discussion
1	Max Stillwater Elevation • High water level • Low water level	582.82 ft (Reference 26) 563.22 ft (Reference 26)
2	Max Wave Run-up Elevation	NA – wind generated wave effects are evaluated under CEF, Table 5.
3	Max Hydrodynamic/Debris Loading	There are no hydrodynamic/debris loading concerns. The PMSS event does not flood the powerblock area due to the site location on a high bluff – approximately 40 ft above nominal Lake level, nominal elevation 620 ft.
4	Effects of Sediment Deposition/Erosion	There will be no sediment deposition/erosion on the site. The PMSS event does not result in site flooding.
5	Other Associated Effects	None identified.
6	Concurrent Site Conditions	No concurrent site conditions were identified.
7	Effects on Ground Water	There will be no groundwater surcharge effects. The PMSS event does not result in site flooding.
8	Warning Time	No specific warning time is identified; however, no actions are required for PMSS response.
9	Period of Site Preparation	No actions are required for PMSS response.
10	Period of Inundation	The PMSS event does not result in site flooding.
11	Period of Recession	The PMSS event does not result in site flooding.
12	Plant Mode of Operation	Plant response to a PMSS event is not Mode dependent.
13	Other Factors	No other factors were identified.

Table 5 CEF Flood Mechanism Parameters

Item	Parameter Description	Values/Discussion
1	Max Stillwater Elevation	581.87 ft, (at the location of maximum wave runup) (Reference 22)
2	Max Wave Run-up Elevation	609.3 ft (References 18, 22 and 30)
3	Max Hydrodynamic/Debris Loading	There are no hydrodynamic/debris loading concerns. The CEF event does not flood the powerblock area due to the site location on a high bluff – approximately 40 ft above nominal Lake level – nominal elevation 620 ft.
4	Effects of Sediment Deposition/Erosion	There will be no sediment deposition on the site. The CEF event does not result in site flooding. Due to the topographic configuration of the site located on a 40 ft bluff on the lake shoreline there is a potential for wave induced bluff erosion.
5	Other Associated Effects	None identified.
6	Concurrent Site Conditions	No concurrent site conditions were identified.
7	Effects on Ground Water	There will be no groundwater surcharge effects. The CEF event does not result in site flooding.
8	Warning Time	No specific warning time is identified; however, no actions are required for CEF response.
9	Period of Site Preparation	No actions are required for CEF response.
10	Period of Inundation	The CEF event does not result in site flooding.
11	Period of Recession	The CEF event does not result in site flooding.
12	Plant Mode of Operation	Plant response to a CEF event is not Mode dependent.
13	Other Factors	No other factors were identified.

6 OVERALL SITE FLOODING RESPONSE

6.1 DESCRIPTION OF OVERALL SITE FLOODING RESPONSE

6.1.1 RESPONSE TO LIP

Key SSC Identification

The key safety functions required by NEI 12-06, as referenced by NEI 16-05, are those which support Core Cooling, Containment Integrity, and Spent Fuel Pool Cooling. The buildings listed below are those which house the primary components of the identified systems. Note, however, that the design of PNPP structures is such that nonsafety-related buildings communicate with safety-related buildings above and below the plant grade level. As such, the protection schemes discussed within the remainder of this report address protecting not just the safety-related buildings which house key systems, but also those structures which could communicate with those structures. The protection will be provided at the environmental/structure interface (incorporated barriers as defined by Regulatory Guide 1.102).

Under design basis conditions (i.e., non-FLEX), Reactor Core Cooling is provided by either the RHR System (Shutdown Cooling Mode) or by a combination of injection systems (RCIC, HPCS, RHR/LCPI or LPCS) and a Suppression Pool Cooling mechanism (RHR in Suppression Pool Cooling Mode); in either case, the credited heat removal function is provided by the ESW System.

Under design basis conditions (i.e., non-FLEX), Containment Integrity is provided by RHR in Suppression Pool Cooling Mode which removes decay heat rejected from the vessel to the Suppression Pool. The credited heat removal function is provided by the ESW System.

Under design basis conditions (i.e., non-FLEX), Spent Fuel Pool Cooling is provided by either the FPCC System or the RHR System in Supplemental Pool Cooling Mode. In either case, the credited heat removal function is provided by the ESW System.

Under design basis conditions (i.e., non-FLEX), electrical power is supplied to the above systems via the Emergency Diesel Generators, safety-related 4160V and 480V switchgear, and related distribution network including component-level controls.

Components for the systems identified above are housed in the following plant safety-related structures: Emergency Service Water Pumphouse, Auxiliary Building (Unit 1), Control Complex, Fuel Handling Building, Intermediate Building, Emergency Diesel Generator Building, Reactor Building (Unit 1).

Flooding Impact

The critical flood elevation is taken as the plant ground level doorway elevation for plant structures, nominally 620.5 ft. Specific control survey data was obtained for each door threshold and is reflected in the results of References 19 and 38. Flooding which results in WSEs in excess of these elevations at the building-environmental interface are assumed to result in plant flooding (floodwater ingress). Floodwater inleakage through unprotected openings is assumed to be sufficient to render the affected Key systems and components non-functional. No specific inleakage evaluation was conducted for the re-evaluated flood hazards.

Identified potential inleakage paths include:

- Plant doorways (mandoors and rollup doors)
- Ventilation intakes
- Fuel Oil Storage Tank Flame Arrestors
- Tank vent lines (oil interceptors)
- Building external siding
- Safety related electrical manholes

Flood Protection Features

Safety-related structures and nonsafety-related structures which can communicate with safety-related structures will be provided with temporary/removable incorporated barriers at doorways deemed to be affected in References 19 and 38. Similarly, exteriors of applicable nonsafety-related buildings will be modified, as necessary, to ensure they are sufficiently capable of withstanding the hydrostatic and hydrodynamic effects (including debris and flood-born missiles) of the LIP event without permitting floodwater inleakage. Safety-related building exteriors are judged to be sufficiently designed for these forces by comparison to the design loads for tornado winds and tornado-born missiles. The Fuel Oil Storage Tank Flame Arrestors and oil interceptor vent lines will be modified, as necessary, to prevent all flood impacts. Curbing around safety related electrical manholes will be modified, as necessary, to protect against the floodwater heights determined in References 19 and 38.

Flood Prevention Strategy

To address the external flooding vulnerabilities discussed above, PNPP will enlist a flooding protection scheme utilizing a combination of permanently installed passive protection (in the form of incorporated barriers) and temporary/removable incorporated barriers installed per operator action. Operator action is initiated on an advanced warning alert based on meteorological forecasting. The barriers, whether temporary or permanent, will be capable of withstanding the static and dynamic loads resulting from the analyzed flood conditions.

Though not credited in this evaluation, additional defense-in-depth is provided by FLEX (as confirmed in the previously submitted Mitigating Strategies Assessment, Reference 12).

6.1.2 RESPONSE TO SRF

As reported in the FHRR, completed modifications to the contractor access road and the rail line bridge are reflected in the analyses. The resulting beyond design basis WSE at the rail line bridge is 628.5 ft (Reference 17). The WSE in the northeast overbank area of 631.43 ft (Reference 25) is within the modified contractor access road elevation in this location. Downstream of the rail line bridge, the water level decreases rapidly as it discharges to the lake. Based on the existing site contours, the stream overbank flow never reaches the site/powerblock area. Based on this, flooding from the Major Stream has no adverse effects on any key safety functions.

The flooding will overtop the main access road for a period of approximately 2.5 hours, but this will have a negligible impact as the site does not require use of the access road to mitigate the effects of SRF (Reference 13).

As discussed earlier, the Diversion Stream and associated earthen berm have been installed to divert all watershed runoff from the Minor Stream. The new design of the stream and berm is evaluated to show that all flood mechanism parameters are adequately addressed (Reference 20).

6.1.3 RESPONSE TO PMSS

The high-water level is 582.82 ft (Reference 26); however, due to the site location on the Lake Erie bluff, the water level does not reach the site elevation of approximately 620 ft. Also, the high lake level does not reach the Emergency Service Water Pumphouse operating floor elevation of 586.5 ft.

The low water level of 563.22 ft (Reference 26) exceeds the design basis level of 565.26 ft (References 21 and 27). Due to the short duration and conservatism in the calculated values, the low water level will have negligible impact on Emergency Service Water Pump operation. Also, the plant water intake structure (which has two intakes) has a top structure elevation of 556.2 ft and 557.2 ft (Structures 1 and 2, respectively) (Reference 33). This yields margin of approximately 6 ft, thus assuring adequacy of the cooling water supply.

6.1.4 RESPONSE TO CEF

The reevaluated CEF (high lake water level with coincident wind wave activity) maximum value of 609.3 ft (References 22 and 18) exceeds the design basis elevation of 607.9 ft (Reference 21). However, due to the site location on the Lake Erie bluff, the increased wave action does not reach the site elevation of approximately 620 ft. and will have no effect on the site. The additional wave action could impact the erosion rate of the bluff, but due to the limited duration, the overall impact is considered negligible. Note that bluff erosion is considered a long-term concern; no single event (such as the CEF) can jeopardize the integrity of the bluff such that key SSCs could be impacted. Periodic inspections/surveys are performed to measure bluff erosion/recession, as described in Section 2.4.5.5 of the PNPP USAR (Reference 21). As discussed therein, PNPP is committed to taking remedial action before the bluff recedes to a point which can impact important to safety structures. Also note that the shoreline is protected with an "interim protection" scheme as discussed in USAR Section 2.4.5.5.9. The interim protection consists of sheet piling and riprap.

6.2 Summary of Plant Modifications and Changes

6.2.1 Permanent Plant Modifications and Changes

As discussed in the FHRR, Revisions 1 and 2, several modifications to the site were completed to support the reevaluated flood hazard analyses for the streams and rivers flooding. These modifications include:

1. New Diversion Stream – divert Minor Stream flow directly to Lake Erie.
2. New engineered earthen berm – to isolate east and south watershed from the site. This will include a Preventative Maintenance Plan for periodic inspections and vegetative cover control.
3. Remove railway approach west of rail line bridge to increase Major Stream flow conveyance area.
4. Increase the elevation of the contractor access road – provide barrier for Major Stream overbank pooling.

The FHRR and ISR are based on the analyses which reflect these modifications.

Subsequently (after the FHRR Revision 1 submittal), it was determined that, based on the increased flood level from the LIP, further evaluation was required. To support the revised analytical results, several modifications/actions are required, as described below. The following list describes these modifications, collectively which support the reconstituted design basis and beyond design basis hazards mitigation. Full implementation of these changes will occur concurrent with implementation of the proposed License Amendment Request and related 10CFR50.12 exemptions. In this way, the response to design basis and beyond design basis LIP hazards will be the same.

1. Provide flood barriers on critical doors. The flood protection features are a combination of raised thresholds, permanent ramps, and removable flood panels (stop log-style gates):
   a. For consequential flooding (as discussed in Section 7.1) – permanent barriers for all hazards up to and including the Standard Project Storm.
   b. For reevaluated flood hazard – deployable temporary barriers stored onsite for all events greater than the SPS up to and including the bounding PMP.
2. Install/upgrade building exteriors – modifications intended to prevent water inleakage past the environmental interface.
3. Additional piping extensions or protection features on the Diesel Generator Fuel Oil Tank Flame Arrestors and on the drain oil interceptor vent lines, as necessary.
4. Additional/raised curbing around safety related electrical manholes.
5. Addition/modification of roof scuppers and parapets.
6. Development of a time-based warning protection scheme in which incorporated barriers (flood panels) will be deployed based on a trigger point, in advance of a significant precipitation event.
7. Performance of a validation of temporary flood barrier installation time, as required by plant procedures.

8. Preventive Maintenance Plans for inspection/repairs will be developed as deemed necessary, for items such as the site storm drain system, flood barriers, Diversion Stream/Berm and Major Stream.

6.2.2 Interim Protection Modifications and Changes

In order to address the interim condition of the site prior to implementation of the permanent changes outlined above, temporary modifications (EC 19-0178-001, 002, 003) have been implemented to provide increased protection from a postulated beyond design basis LIP hazard. These changes have been implemented in accordance with PNPP licensee commitments L-19-068-1 and L-19-068-2. The protection features are sized based on analyses of the current "as-found" conditions of the site as determined in Reference 45.

For ground-level hazards, protection features include pre-deployed temporary barriers and stored barriers deployed per procedural guidance, all of which have been implemented via temporary modification. Pre-deployed barriers are in the form of sandbags located along vulnerable lengths of building exteriors (judged to potentially permit gross inleakage) and select plant roll-up doors. Other ground-level locations, such as the fuel oil storage tank flame arresters have been protected with temporary wooden barriers. Stored barriers are in the form of removable stop log barriers and sandbags and are used to protect mandoors and roll-up doors potentially impacted by the reevaluated LIP flood hazard. Stop log barriers are stored centrally within the Protected Area. Sandbags are stored locally near the point of deployment with a sufficient quantity for each of the locations to be protected.

For roof-level openings, a combination of wooden barriers and sandbags have been utilized to mitigate gross inleakage at doorways and other construction openings. Wooden barriers are pre-deployed. Sandbags are stored locally near the point of deployment with a sufficient quantity for each of the locations to be protected.

Guidance for barrier deployments has been incorporated into ONI-ZZZ-1 (Reference 36). For both pre-deployed and stored locations, guidance for sandbag deployment has been obtained from the U.S. Army Corps of Engineers. Use of this guidance as supplemented by the governing Engineering Change, ensures the reliability and adequacy of the barriers. For locations protected by stop log barriers, vendor requirements have been incorporated. These barriers are designed and tested per the guidance of ANSI/FM-2510, thus ensuring the reliability and adequacy of the barriers.

Barrier deployment is initiated based on receipt of a meteorological forecast warning as dictated by plant procedure ONI-ZZZ-1 (Reference 36). Entry into this off-normal instruction is made as a result of a meteorological forecast received from a meteorological monitoring service. For interim protection deployment, a trigger level of 6"/3hr of precipitation is used. These actions and protection features have been incorporated into the site's external flooding Prompt Functionality Assessment (PFA) thus aligning the interim beyond design basis and design basis functionality requirements. This ensures one set of actions and procedures govern all necessary external flood-related requirements.

The above interim protection schemes will remain in place until final modifications are complete and the proposed License Amendment Request and related 10CFR50.12 exemptions are approved and implemented.

7 FLOOD IMPACT ASSESSMENT

7.1 FLOOD MECHANISM: LOCAL INTENSE PRECIPITATION (PATH 2 ASSESSMENT)

7.1.1 DESCRIPTION OF FLOOD IMPACT

Available Physical Margin

Table 6: LIP APM Evaluation

Location	Critical Elevation	LIP Flood Elevation(2)	Available Physical Margin
Buildings and openings- with upgrades complete/door flood panels installed	Varies	621.65 ft (621.69)(7)	Minimum 1 inch for all openings(1)
Fuel Oil Storage Tank Flame Arrestors	621.17 ft(3)	621.29 ft (621.31)	Minimum 1 inch(1)
Tank vent lines (oil interceptors) (worst case: OIL4)	621.92 ft(4)	621.43 ft (621.49)	0.49 ft (0.43 ft)(2)
Flood curbing on Electrical Manholes (worst case: EMH3)	620.75 ft(5)	620.93 ft (620.93)	1.76 inches (1.76 ft)(1)(2)
Flood curbing for Emergency Service Water compartment vents (weep holes) (worst case: ESWEEP3)	620.50 ft(6)	620.27 ft (620.21)	0.23 ft (0.29 ft)(2)

(1) Based on completion of modifications, as necessary, discussed in Section 6.2.
(2) Maximum value from Calc 50:66.000 output result files. Values shown in parentheses are obtained from Calc 50:66.001
(3) Reference drawing 744-0035-00000 and Vendor document: Tokheim Flame Arresters 85-2.
(4) Reference drawing 303-0021-00000.
(5) Reference drawing 426-0603-00000.
(6) Reference drawings 426-0312-00000 and 426-0313-00000.
(7) This value represents the WSE at the plant doorway with the highest floodwater depth.

Relevant Associated Effects

As previously discussed, impacts related to associated effects are negligible.

Due to the low velocities (generally less than 10 ft/sec) of the flood waters and the power block area consisting of hard surface materials (the area is mostly macadam and concrete), scour and erosion is not considered an issue.

Debris loading was evaluated due to the high-water level during the peak flood condition and found to be acceptable (Reference 34). Forthcoming permanent and removable incorporated barriers are designed and/or tested with respect to this loading and will be capable of withstanding the entire range of loading effects.

Hydrostatic and hydrodynamic loading impacts on the buildings has been evaluated and found to be acceptable (Reference 34). Forthcoming permanent and removable incorporated barriers are designed and/or tested with respect to this loading and will be capable of withstanding the entire range of loading effects.

Groundwater effects on buildings and flood barriers, including penetration seals, are negligible due to the generally impermeable nature of the ground surface surrounding the powerblock, the relative shallow depth of flooding, and the short duration of the flooded condition. Additionally, the plant is provided with an Underdrain System which is designed to maintain subsurface hydrostatic pressures below design limits.

Consequential Flooding

It was determined that the consequential flood level that could adversely impact key SSCs is based on the evaluation performed for the Standard Project Flood. Once all modifications are completed, PNPP will be protected up to and including the Standard Project Storm using passive (permanently installed) flood protection features. For any precipitation event larger than the Standard Project Storm, which includes the beyond design basis PMP event, the temporary flooding protection features will be deployed per site operational procedure prior to the event. Therefore, consequential flooding is adequately addressed.

7.1.2 ADEQUATE APM JUSTIFICATION AND RELIABILITY FLOOD PROTECTION

APM evaluations are performed in accordance with NEI 16-05, Appendix B. The evaluations are based on the full implementation of the flood mitigation modifications/actions, discussed previously in Section 6.2.

Flood Mitigation Barriers

Permanent incorporated barriers include – building siding, electrical manhole curbing, and ESW weep holes as necessary. Also, additional piping extensions or barriers for Diesel Generator Fuel Oil Flame Arrestors and floor drain oil interceptor vents may be needed.

Removable flood barriers include – door panels deployed (or validated as installed) based on a trigger event alert.

The margin provided for each barrier is anticipated to be a minimum of 1 inch for the Consequential Flood (Standard Project Flood) and 1 inch for the reevaluated beyond design basis PMP event. All of the barriers will be evaluated and demonstrated to be acceptable/qualified for hydraulic/hydrodynamic loading for the worst flood levels. Also, the barriers will be shown to be acceptable for potential impacts from debris in the flood water. The removable flood barriers will be stored in a readily accessible location with proceduralized installation details. Periodic inspections of the door flood barriers will ensure availability and readiness. Flood panel installation timing validation, as required by plant procedures, will ensure that the estimated warning time is sufficient.

The margin values presented in Table 6 above do not meet the general guidance for APM as discussed in Section B.1 of Appendix B of Reference 5 (2-4 ft as cited for rivers and streams analyses). However, the margin values are consistent with the discussion provided in Section B.1 of Appendix B of Reference 5 regarding "negligible or zero APM." Consistent with this guidance, these magnitudes are acceptable based on the conservative nature of inputs, assumptions and methods used to determine the re-evaluated LIP flood hazard. The supporting analyses employ a two-dimensional methodology (FLO-2D Pro) which inherently does not omit the effects of runoff complications as would be seen if using simplified techniques such as the Manning formula. The models captured in References 19 and 38 are developed with conservative assumptions, similar to some of those discussed in Table A-1 of Reference 5. Specifically, References 19 and 38 assume no soil infiltration or evaporation (zero runoff losses), maximized boundary conditions (maximum lake level and Major Stream PMF elevation), conservative inputs/assumptions (inclusion of a postulated Diversion Stream berm failure inflow and ESW swale discharge inflow) and partial obstruction of the storm drain system.

Consequently, the analyses (and therefore results) are inherently conservative and thus the presence of small magnitude margin is considered acceptable.

Barrier Penetration Seals

As evaluated in the Mitigating Strategy Assessment, penetration seals and plugs relied upon to protect plant equipment were inspected and found to be capable of performing their intended function. A review of the Available Physical Margin (APM) calculations contained in Technical Assignment File 81991 (Reference 35) indicates which seals were determined to be subject to a LIP. This is a small subset of the seals walked down as part of the 10CFR50.54f, Request for Additional Information, 2.3 Flooding Walkdown results (Reference 11). It has been determined that the LIP event does not cause a measurable groundwater surcharge due to its short duration, low water depth and the generally impermeable materials surrounding a large portion of the power block area. Also, as documented in USAR Section 2.4.13.5.5.c.3, the effects of a PMP event on groundwater is negligible. As stated in the USAR, around the nuclear island buildings, the ground surface will be paved with asphalt or backfilled with relatively impervious Class B fill of excavated lower till soils. The rate of infiltration through the Class B fill is insignificant.

Diversion Stream Berm

The berm forms the eastern boundary of the LIP domain and, as such, berm structural reliability must be considered. A berm failure analysis has been performed and the maximum/peak flow from a failure of the Diversion Stream channel berm is assumed to be concurrent with the peak intensity of the LIP event and is modeled as a fixed boundary condition/input (Reference 38). The assumption is conservative because it assumes that the LIP event occurs coincidentally with an instantaneous, fully developed breach of the Diversion Stream channel berm containing the Diversion Stream PMF. The fully developed breach profile is assumed to be present for the entire simulation. Flow through the breach would be dependent only on the time-based elevation of the Diversion Stream and not dependent on breach propagation. However, as a conservative modeling technique, the peak flow rate through a postulated berm failure is applied to the LIP model for the entire precipitation event duration (Reference 38). This ensures that maximum effect of such an event is captured for plant structures.

Plans are being developed for periodic berm inspection and repair as needed; however, as noted above, berm reliability is not critical since failure has been accounted for in the LIP event.

Storm Drain System

To minimize potential flood water depths at critical doors, the passive storm drain system is credited as being functional in the LIP model to assist in site drainage. Conservatively, the drain system is assumed to be partially blocked (pipe capacity and inlet area reductions are applied); however, a recent inspection and debris removal resulted in a relatively clean system. To ensure availability of the storm drain system during a LIP event, a preventive maintenance action will be developed to include periodic inspection and cleaning or repair, as required.

Associated Effects

As previously discussed, impacts related to associated effects are negligible.

7.1.3 Adequate Overall Site Response

This evaluation, performed in accordance with NEI 16-05 Appendix C, has demonstrated the overall site response to local intense precipitation is conceptually adequate. As discussed in Section 6.2, various modifications, in conjunction with the time-based warning protection

scheme, will prevent water ingress into areas that could potentially affect key SSCs. The following sections outline the results of evaluating the criteria in NEI 16-05 Appendix C.

7.1.3.1 Defining Critical Path and Identifying Time Sensitive Actions

The overall strategy for protecting PNPP from local intense precipitation contains relatively simple and straightforward actions. The critical path and time sensitive actions (TSAs) include:

1. Identifying a severe weather event
2. Dispatching personnel to deploy (or validate deployment of) flood barriers in accordance with revised and/or new plant off-normal operational procedure(s)

Anticipatory installation of temporary flood barriers described above are considered TSAs. Procedure updates will include actions for door flood panel installation/verification details and diagrams for specific door location identification.

7.1.3.2 Demonstration all TSAs are Feasible

The estimated time to complete installation of temporary flood barriers is less than 12 hours and the estimated warning time is 24 hours. All TSAs are considered feasible and can be performed prior to the reevaluated flood hazard event. Formal validation of the personnel deployment and door flood panel installation/verification will be performed in accordance with site procedure PAP-0550-3 (Reference 37), as necessary, similar to the validation for the FLEX Program. This will satisfy the NEI 12-06 and NEI 16-05 requirements.

7.1.3.3 Establishing Unambiguous Procedural Triggers

The site will receive a trigger event alert of heavy rainfall or severe thunderstorm warning from qualified weather monitoring/forecast service. Also, Operations personnel will be procedurally required to monitor the weather forecasts once per shift (12-hour shifts) based on a monitoring threshold alert. Either the trigger event alert or monitoring threshold alert will trigger the initiation of flood protection actions in accordance with procedures.

7.1.3.4 Proceduralized and Clear Organizational Response to a Flood

Plant off-normal operating procedure(s) will be revised to provide clear guidance on the responsibilities for verifying door flood panels are properly installed and provide directions and locations for installing the temporary flood panels. The Shift Manager will ultimately be responsible for implementing the mitigating actions once the alert is received.

7.1.3.5 Detailed Flood Response Timeline

The door barriers required to protect key SSCs and prevent the loss of a KSF will be stored in a readily accessible location on site. The configuration and placement of the barriers will be completed in accordance with new/revised plant off-normal operating procedure(s). These actions will be validated to confirm that, based on the trigger event alert, sufficient time is available prior to a severe storm, if necessary, in accordance with plant administrative procedures. When the action trigger is initiated, the site will begin actions to install flood protection features with an estimated window of 24 hours prior to the earliest initiation of the consequential event. If installation and verification of the planned flood protection features are completed within an estimated 12 hours, a margin of 12 hours will be maintained. This demonstrates that there is ample time to complete the actions required to install flood barriers at the critical doors.

7.1.3.6 Accounting for the Expected Environmental Conditions

Based on the advanced warning due to the trigger event alert and/or monitoring threshold alert, the environmental conditions expected during the deployment of personnel for temporary flood barrier installations are not expected to change any actions. Also, installation of the majority of the barriers will be from the interior of the buildings. The advanced warning of a storm will provide sufficient time prior to the onset of severe weather. Given the amount of time expected to complete the action, the simple nature of personnel actions and the ease of accessibility, it is highly unlikely that conditions will deteriorate in such a way as to impede installing the flood protection.

7.1.3.7 Demonstration of Adequate site response

The site response to a LIP flood event will be consistent with the guidance in Appendix C of NEI 16-05 after the completion of the specified site modifications, procedure revisions and action validations. All TSAs were identified and determined to be feasible. The time margin is estimated to be 12 hours given the estimated time available as 24 hours and the estimated time required to execute of less than 12 hours. The organizational structure and command and control will be clearly detailed in new/revised plant off-normal operating procedure(s), including barrier location details, installation details/diagrams and required actions. Finally, the environmental conditions are not expected to be adverse at the time of site preparation activities.

This evaluation demonstrates that the overall site response is adequate for a LIP event per the NEI 16-05 guidance.

7.2 Flood Mechanism: Streams and Rivers Flooding

7.2.1 Description of Flood Impact (Path 2 assessment)

Available Physical Margin

Site topographic conditions combined with the short duration of the SRF event prevents the flooding from impacting the key SSCs. The relative APM values are noted below. Since the maximum flood elevation does not impact any key SSCs, there is no consequential flood.

Table 7: SRF APM Evaluation

Location	Critical Elevation	Maximum CEF Elevation	Available Physical Margin
Major Stream	630.93 ft(1) (min along rail line cross section)	628.5 ft (max WSE along rail line cross section)	2.43 ft
Diversion Stream	631.15 ft(2) (Berm elevation)	629.2 ft	1.95 ft

(1) From calc 50:62.000 (Reference 17), the minimum grade along the rail line is approximately 630 ft NGVD88, which converts to 630.93 ft NGVD29 PLD.

(2) From calc 50:33.000 (Reference 20), Table A17.3, berm elevation at location of minimum APM.

Relevant Associated Effects

There are no identified associated affects for the powerblock area since the Major Stream and Diversion Stream do not flood the site.

There also is a drainage depression area that, based on the probable maximum flood (PMF) site-specific rainfall, has the potential to reach flood levels that could overflow the watershed boundaries and contribute to site flooding. The drainage depression area is located in the Major Stream watershed south of the plant area upstream of the rail line, between the rail line and the secondary access road. A volume analysis, assuming no drainage, was performed and determined that a maximum WSE of 631.44 ft would still be bounded by the modified secondary access road (Reference 25). This confirms that the design modifications provided are sufficient to ensure rainfall runoff in the drainage depression area contributes only to the Major Stream watershed and does not contribute to flooding of the site powerblock area.

The flooding from the Major Stream will overtop the main site access road, downstream of the rail line, temporarily preventing vehicle passage. The total inundation and recession period is approximately 2.5 hours (Reference 13). The short duration of the road closure would have a negligible impact on the site. Also, though not credited in this evaluation, additional defense-in-depth is provided by FLEX (as confirmed in the previously submitted Mitigating Strategies Assessment). The assessment concludes that site isolation for the 2.5 hours is inconsequential.

The earthen berm could be affected by erosion, and as such an evaluation was performed to consider a piping or internal erosion failure during the peak water surface elevation. The resulting flow through the failed area would discharge to the Remnant Minor Stream and flow to the lake. To address the effects of this failure, the flow was added to the LIP domain (References 19 and 38). LIP protection strategies inherently account for the effects of Diversion Stream berm failure contributions to site (powerblock) flooding.

Therefore, impacts related to associated effects are inherently addressed via LIP actions.

7.2.2 ADEQUATE APM JUSTIFICATION AND RELIABILITY FLOOD PROTECTION

As demonstrated above, protection to all site areas is provided by the plant site grade itself and the Diversion Stream berm. Site grade and topography, which is inherently permanently-installed and passive, protects the plant from SRF flooding. The Major Stream inundation profile (Reference 17) shows the site topography adequately segregates the plant from the Major Stream floodplain. Because the Major Stream does not contribute to site flooding, there are no resulting effects with respect to erosion, groundwater, structural loading or sedimentation.

Similarly, the Diversion Stream inundation profile (Reference 20) shows the earthen berm to adequately segregate the plant from the Diversion Stream floodplain. Because the Diversion Stream does not contribute to site flooding, there are no resulting effects with respect to erosion, groundwater, structural loading or sedimentation.

Per review of Section B.1 of Reference 5, the APM is less than the generic 2.5-3 ft value obtained from USACE and FEMA documentation. However, the analyses which determine the available margin are inherently conservative based on the inputs, assumptions and methodologies. For example, no soil infiltration is credited for the rainfall to runoff transformation process used to develop streamflow hydrographs. Similarly, the precipitation inputs are probable maximum precipitation events which are developed using relevant industry guidance. Further, the methodology used is industry accepted and implemented through the USACE HEC-RAS computer program. It can also be noted that PNPP's SRF hazard is the result of two relatively small neighboring streams, not large watercourses. This presents inherently less variables due to the small basin size and minimal likelihood of significant basin development. Collectively, this shows the APM is inherently adequate, based on the guidance of Appendix B of Reference 5, as noted in Section B.1.

Since the Diversion Stream APM is reliant on the function of the earthen berm (embankment), an inspection/monitoring procedure will inspect for erosion and degradation to ensure that the berm structural integrity is not adversely affected over time. Also, preventive maintenance guidelines for debris clearing/vegetative groundcover maintenance are being developed. As part of the Diversion Stream/berm construction permits, a 10-year monitoring program has been established and includes trending of settlement or slope changes and periodic reviews of vegetative growth. Similarly, for the elevated roadway (embankment) which contains the PMF profile for the Major Stream, a maintenance plan will be developed which will inspect the roadway and underlying surface for evidence of failure mechanism initiators. These maintenance and inspection plans serve to ensure the reliability of the embankments thus ensuring they are available when needed to function as flooding barriers.

7.2.3 ADEQUATE OVERALL SITE RESPONSE

PNPP is permanently and passively protected from the entire range of SRF hazards. Therefore, this section is not applicable to PNPP as no additional manual actions are required to implement the flood protection strategy for an SRF event. No temporary flood mitigation equipment is required.

7.3 Flood Mechanism: Probable Maximum Storm Surge

7.3.1 Description of Flood Impact (Path 2 assessment)

Available Physical Margin

Table 8 below summarizes the available physical margin relative to the PMSS hazard. As shown in the table, PNPP is passively protected from the effects of the PMSS.

Table 8: PMSS APM Evaluation Summary

Location	Critical Elevation	PMSS Elevation	Available Physical Margin
High water level	620 ft (nominal top of bluff)	582.82 ft	37+ ft
	586.5 ft (ESWP operating floor)		3.68 ft
Low water level	554.48 ft (Min level for ESW A/B/C Pump operation)	563.22 ft	8.74 ft
	556.9 ft (Lake water intake structure)		6.32 ft

PMSS High Water Considerations

Per Calculation 50:47.000 (Reference 26), the PMSS event results in a stillwater elevation of 582.82 ft. This is well below the nominal site grade elevation of 620 ft. The physical protection is provided via the bluff on which the plant is situated, which overlooks Lake Erie. The only plant structure which houses key systems and components, which is also hydraulically coupled to Lake Erie, is the Emergency Service Water Pumphouse (ESWPH). Per plant drawing 015-0002-00000 (Reference 27), the ESWPH operating floor (the lowest elevation of flood-sensitive equipment) is at elevation 586.5 ft. As such, high-water due to the PMSS does not affect PNPP's ability to perform key safety functions.

PMSS Low Water Considerations

The resulting low stillwater elevation resulting from the PMSS for beyond design basis is 563.22 ft (Reference 26). Additionally, per References 21 and 27, a simultaneous start of the Emergency Service Water and Service Water pumps will result in an additional draw down of 3.17 ft. This additional drawdown is considered herein for consistency with the existing design basis. This results in a low water elevation of 560.05 ft. This elevation is compared to the minimum ESW pump submergence depth and depth to prevent vortexing. These values are displayed in Table 9 below. As demonstrated, the critical elevation for these considerations is 556.38 ft, yielding a minimum margin value of 3.67 ft. Net Positive Suction Head (NPSH) is tabulated in Table 10 below. For this consideration, the vendor-provided required NPSH

($NPSH_R$) is compared to the PMSS minimum elevation, accounting for pump drawdown. Even under this conservative consideration, a minimum margin value of 4.877 ft is available. With the minimum submergence, vortexing and $NPSH_R$ considerations addressed, proper operation is assured for these pumps.

Additionally, the plant intake structure (which has two intakes) has a top plate (velocity cap) elevations of 556.9 ft and 555.9 ft per drawing 726-0210-00000 (Reference 33). The bounding value of 556.9 ft is also included in Tables 9 and 10 below. By comparison to the PMSS low water elevation, a sufficient water supply for the ESW System is assured as the intake structures remain fully submerged during the PMSS event. Nonetheless, it can be seen that if the top of the structure is taken as the controlling value, sufficient margin (in excess of three feet) remains present.

Table 9: Minimum Submergence Depth to Prevent Pump Vortexing

Pump	Suction Bell Flange Elevation[1] (ft)	Required Submergence[1] (ft)	PMSS Low Lake Level + Drawdown[2] (ft)	Margin[3] (ft)	Critical Lake Level[4,5]
ESW A/B	548.33	4.3	560.05	7.42 (3.15)	552.63 (556.9)
ESW C	552.48	2	560.05	5.57 (3.15)	554.48 (556.9)
Screen Wash	554.88	1.5	560.05	**3.67 (3.15)**	**556.38 (556.9)**

Note 1: Values obtained from Calculation P45-081 (Reference 31).
Note 2: PMSS WSE of 563.22 ft – 3.17 ft = 560.05 ft. 3.17 ft represents forebay level drop due to simultaneous starting of all Emergency Service Water and Service Water pumps. 563.22 ft elevation from Reference 26; 3.17 ft from Reference 31.
Note 3: Margin taken as (PMSS Low Lake Level + Drawdown) – Critical Lake Level.
Note 4: Critical Lake level is Suction Bell Flange Elevation + Required Submergence.
Note 5: Plant cooling water intake structure has a top of plate (velocity cap) elevation of 556.9.

Table 10: Net Positive Suction Head Review

Pump	First Stage Impeller Eye El.[1] (ft)	Required NPSH[1]	Additional NPSH at PMSS Low Lake Level + Drawdown[2] (ft)	Margin[3]	Critical Lake Level[4,5]
ESW A/B	549.917	35	42.8	7.80 (3.15)	552.25 (556.9)
ESW C	553.015	17	39.71	7.035 (3.15)	553.015 (556.9)
Screen Wash	555.173	24	37.55	**4.877 (3.15)**	**555.173 (556.9)**

Note 1: Values obtained from Calculation P45-081 (Reference 31).
Note 2: $NPSH_A = h_a - h_{vpa} + h_{st}$ (formula per Reference 31). h_a = 33.267, h_{vpa} = 0.59583 for all pumps; h_{st} = 560.05 ft – First Stage Impeller Eye elevation.
Note 3: Margin taken as (PMSS Low Lake Level + Drawdown) – Critical Lake Level.
Note 4: Critical Lake level is either the elevation at which $NPSH_A = NPSH_R$ or the First Stage Impeller Eye elevation, whichever is higher.
Note 5: Plant cooling water intake structure has a top plate (velocity cap) elevation of 556.9.

Relevant Associated Effects

There are no associated affects identified.

7.3.2 Adequate APM Justification and Reliability Flood Protection

As demonstrated above for the high-water level, protection to all areas is provided by the plant site grade itself. The bluff, which is inherently permanently-installed and passive, protects the plant from flooding. Also, the ESW Pumphouse design provides adequate margin such that the high-water level will not impact the operation of safety equipment. By inspection of the above margin values, there is ample margin between the PMSS elevation and the nominal plant grade elevation. This margin is clearly adequate under the guidance of Reference 5, Appendix B. The bluff is also considered inherently reliable based on the inspection program discussed in Section 6.1.4 above. This ensures the reliability of the bluff thus ensuring it is available when needed to function as a flooding barrier.

For low water level, there is over 6 ft of margin at the plant water intakes. The NPSH and submergence requirements for the ESW pumps are based on the design lake level of 565.26 ft which is above the PMSS minimum of 563.22 ft. However, the ESW pump evaluation shows that a minimum margin of 3.67 ft is available ensuring operation of the pumps is acceptable under the low lake level conditions.

Additionally, although not credited in this evaluation, the FLEX mitigation strategies have been shown in Reference 13 to be successful under the beyond design basis low water level.

7.3.3 Adequate Overall Site Response

This section is not applicable to PNPP as no additional manual actions are required to implement the flood protection strategy for a PMSS event. No temporary flood mitigation equipment is required.

7.4 FLOOD MECHANISM: COMBINED EFFECTS FLOOD

7.4.1 DESCRIPTION OF FLOOD IMPACT (PATH 2 ASSESSMENT)

Available Physical Margin

Site topographic conditions prevents the CEF from impacting the key SSCs. The relative APM values are noted below. Since the maximum flood elevation does not impact any key SSCs, there is no consequential flood.

Table 11: CEF APM Evaluation

Location	Critical Elevation	Maximum CEF Elevation	Available Physical Margin
East of the power block along the lake shoreline/north bluff	620 ft (nominal top of bluff)	609.3 ft	10.7 ft

Relevant Associated Effects

There are no associated affects identified.

7.4.2 ADEQUATE APM JUSTIFICATION AND RELIABILITY FLOOD PROTECTION

As demonstrated above, protection to the site and powerblock area is provided by the plant location and site grade itself. The bluff, which is inherently permanently-installed and passive, protects the plant from flooding. By inspection of the above margin values, there is ample margin between the CEF elevation and the nominal plant grade elevation. This margin is clearly adequate under the guidance of Reference 5, Appendix B.

Shore protection is provided along the north shore of the plant to mitigate the adverse effects of the wave action on the bluff face. The shore protection consists of armor stone and steel sheet piling installed with a top of steel elevation of approximately 580.25 ft (Reference 21). Since the wind generated wave maximum elevation exceeds the top of the sheet pile, erosion of the bluff is considered. However, due to the isolated and relatively short duration of the wind event, the adverse effects are minimal. Note that bluff erosion is considered a long-term concern; no single event (such as the CEF) can jeopardize the integrity of the bluff such that key SSCs could be impacted. Periodic inspections/surveys are performed to measure bluff erosion/recession, as described in Section 2.4.5.5 of the PNPP USAR (Reference 21). As discussed therein, PNPP is committed to taking remedial action before the bluff recedes to a point which can impact important to safety structures. The bluff is also considered inherently reliable based on this inspection program. This ensures the reliability of the bluff thus ensuring it is available when needed to function as a flooding barrier.

7.4.3 ADEQUATE OVERALL SITE RESPONSE

This section is not applicable to PNPP as no additional manual actions are required to implement the flood protection strategy for a CEF event. No temporary flood mitigation equipment is required.

8 CONCLUSION

This evaluation has determined that the unbounded external flooding events previously identified in the FHRR, do not impact any key SSCs or challenge key safety functions at PNPP after implementation of various actions/physical modifications to the site.

The reevaluated local intense precipitation is not bounded by the current licensing basis. The evaluation concluded that the LIP was determined to generate a water level in the powerblock area that exceeds the current licensing basis and would be above many door thresholds potentially challenging key safety functions. In conjunction with the current design basis reconstitution effort, PNPP is developing a flooding protection scheme utilizing a combination of permanently installed passive protection (in the form of incorporated barriers) and temporary/removeable incorporated barriers deployed per operator action. This will align the design basis and beyond design basis flood responses using the bounding hazard information to size protection requirements. Consistent with the proposed forthcoming License Amendment Request and related 10CFR50.12 exemptions, Operator action is initiated on an advanced warning alert from a trigger event alert and/or monitoring threshold alert, based on meteorological forecasting. This FE demonstrated the site response is adequate, pending site modifications and procedure updates.

In addition, interim protection has been provided for the beyond design basis LIP hazard as previously discussed in response to PNPP commitments L-19-068-1 and L-19-068-2.

The reevaluated streams and rivers flooding is not bounded by the reconstituted design basis. However, the site powerblock area is unaffected since the flooding from the Major Stream and the recently installed Diversion Stream does not inundate the site. The Major Stream overbank area is flooded, including the site access road, but there is no impact on any plant SCCs. Also, it is shown that the total duration of the site access road flooding is inconsequential. The Diversion Stream flooding is contained by the recently installed earthen berm with sufficient margin. Potential berm failure is incorporated into the LIP domain; thus, LIP protection schemes inherently address any flooding contribution therefrom. There are no active flooding protection features or required site response for the SRF event.

The reevaluated probable maximum storm surge, including both high and low lake water levels, is not bounded by the design basis. The high level exceeds the design basis by several feet; however, protection is provided by the site location on the bluff overlooking Lake Erie. Also, the operating deck of the Emergency Service Water pumps is several feet above the reevaluated high-water level. Significant margin is provided by these passive features. The low water level exceeds the PNPP design basis; however, it was shown that at the conservatively calculated minimum lake level, margin remains with respect to the operation of the pumps required for KSFs.

The reevaluated combined events flooding of high lake water level with wind wave action is not bounded by the design basis. The primary feature protecting the site from the CEF is the location on the bluff overlooking Lake Erie along with the shore protection features. It was concluded that this provides reliable flood protection against the applicable flood parameters and significant margin exists such that there is no impact.

In summary this Focused Evaluation concludes that, with the identified site modifications and program changes, the site flooding protection features provide adequate response to the FHRR and ISR identified reevaluated flood hazards that were not bounded by the design basis.

Additionally, the minimum lake surface elevation due to a PMSS (not discussed in the ISR) was included in this evaluation and found to be acceptable.

Submittal of this Focused Evaluation completes the actions for the Fukushima Response related to External Flooding required by the March 12, 2012 10CFR50.54(f) letter.

ATTACHMENT A, Reevaluated Flood Hazards Table

Revised Table 2 from NRC Letter ML 16202A348, Enclosure ML 16202A417

Mechanism	Stillwater Elevation	Waves/ Runup	Hazard Elevation	Reference
Local Intense Precipitation				
Power Block	621.65 ft	Not applicable	621.65 ft	FHRR Rev 2 Section 3.2.9 & Table 8, References 19 & 38 (see note 1)
Streams and Rivers				
Major Stream	628.5 ft	Not applicable	628.5 ft	FHRR Rev 2 Section 3.2.2 & Table 8, Reference 17
Diversion Stream	629.2 ft	Not applicable	629.2 ft	FHRR Rev 2 Section 3.2.2 & Table 8, Reference 20
Storm Surge				
High Water: West of the Power Block Along the Shoreline Bluff Slopes	582.8 ft	Not applicable	582.8 ft	FHRR Rev 2 Section 3.2.6 & Table 8, Reference 26 (see note 2)
Low Water	563.2 ft	Not applicable	563.2 ft	FHRR Rev 2 Section 3.2.6 & Table 8, Reference 26
Combined Effect Flood				
East of the Power Block Along the Shoreline Bluff Slopes	581.9	27.5ft	609.3	References 18, 22 and 30 (see note 2)

Note 1: Maximum water surface elevation at the evaluated door is approximately 1.4 ft above the door threshold. This door location reflects the least margin determined by References 19 & 38.

Note 2: Maximum water surface elevation is 582.8 ft occurs west of the power block along the shoreline bluff slopes. The maximum effects due to wind wave activity occur at a different location just east of the power block along a section of shoreline with steeper bluff slopes. The PMSS maximum water surface elevation at this location is 581.9 ft. (Total of 609.3 ft). Wave/runup value presented is conservatively rounded up from the calculated value of 27.43 (Reference 22).

All elevation values are in NGVD29 PLD, unless noted otherwise.