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

May 3, 2018

Mr. David B. Hamilton
Site Vice President - Nuclear
FirstEnergy Nuclear Operating Company
Perry Nuclear Power Plant
P.O. Box 97
Mail Stop A-PY-A290
Perry, OH 44081-0097

SUBJECT: PERRY NUCLEAR POWER PLANT, UNIT 1– FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NO. MF7960; EPID L-2016-JLD-0007)

Dear Mr. Hamilton:

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations*, Section 50.54(f), (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807).

Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

By letter dated July 24, 2017 (ADAMS Accession No. ML17205A336), FirstEnergy Nuclear Operating Company (the licensee) submitted the mitigation strategies assessment (MSA) for Perry Nuclear Power Plant, Unit 1 (Perry). The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazard(s) within their mitigating strategies for beyond-design-basis external events. The purpose of this letter is to provide the NRC's assessment of the Perry MSA.

The NRC staff has concluded that the Perry MSA was performed consistent with the guidance described in Appendix G of Nuclear Energy Institute 12-06, Revision 2, as endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-01, Revision 1

(ADAMS Accession No. ML15357A163), and that the licensee has demonstrated that the mitigation strategies, if appropriately implemented, are reasonably protected from reevaluated flood hazards conditions for beyond-design-basis external events. This closes out the NRC's efforts associated with CAC No. MF7960 and EPID L-2016-JLD-0007.

If you have any questions, please contact me at 301-415-3809 or at via e-mail at Juan.Uribe@nrc.gov.

Sincerely,

Juan F. Uribe, Project Manager
Beyond-Design-Basis Management Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket No. 50-440

Enclosure:
Staff Assessment Related to the
Mitigating Strategies for Perry

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT RELATED TO THE MITIGATION STRATEGIES ASSESSMENT FOR PERRY NUCLEAR POWER PLANT, UNIT 1 AS A RESULT OF THE REEVALUATED FLOODING HAZARDS REPORT NEAR-TERM TASK FORCE RECOMMENDATION 2.1- FLOODING (CAC NO. MF7960; EPID L-2016-JLD-0007)

1.0 INTRODUCTION

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f), (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807). Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective site(s) using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses.

Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). That order required operating reactor licensees and construction permit holders to modify the plants to provide additional capabilities and defense in depth for responding to beyond-design-basis external events, and to submit to the NRC for review a report that describes how compliance with the requirements of Attachment 2 of the order was achieved. In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not have been based on present-day methodologies and guidance, in the development of their mitigating strategies.

The NRC staff and industry recognized the difficulty in developing and implementing mitigating strategies before completing the reevaluation of flood hazards. The NRC staff described this issue and provided recommendations to the Commission on integrating these related activities in COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluat[i]on of Flood Hazards," dated November 21, 2014 (ADAMS Accession No. ML14309A256). The Commission issued a staff requirements memorandum on March 30, 2015 (ADAMS Accession No. ML15089A236), affirming that the Commission expects licensees for operating nuclear power plants to address the reevaluated flood hazards, which are considered beyond-design-basis external events, within their mitigating strategies.

Nuclear Energy Institute (NEI) 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625), has been endorsed by the NRC as an appropriate methodology for licensees to perform assessments of the mitigating

strategies against the reevaluated flood hazards developed in response to the 50.54(f) letter. The guidance in NEI 12-06, Revision 2, and Appendix G in particular, supports the proposed Mitigation of Beyond-Design-Basis Events rulemaking. The NRC's endorsement of NEI 12-06, including exceptions, clarifications, and additions, is described in Japan Lessons-Learned Division (JLD) Interim Staff Guidance (ISG) JLD-ISG-2012-01, Revision 1, "Compliance with Order EA 12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML15357A163). As discussed in JLD-ISG-2012-01, Appendix G of NEI 12-06, Revision 2, describes acceptable methods for demonstrating that the reevaluated flooding hazard is addressed within the Perry Nuclear Power Plant, Unit No.1 (Perry) mitigating strategies for beyond-design-basis external events.

2.0 BACKGROUND

On July 25, 2016 (ADAMS Accession No. ML16202A350), the NRC issued an interim staff response (ISR) letter for Perry. The ISR letter provided the reevaluated flood hazards that exceeded the current design basis (CDB) for Perry and were suitable input for the mitigating strategies assessment (MSA) (i.e., the mitigating strategies flood hazard information (MSFHI) described in NEI guidance document NEI 12-06). For Perry, the mechanisms listed as not bounded by the CDB in the letter (ISR flood levels) were local intense precipitation (LIP), streams and rivers, and storm surge. By letter dated January 24, 2018 (ADAMS Accession No. ML18002A555), the NRC issued a staff assessment to the flood hazard reevaluation report (FHRR) that provided the documentation supporting the NRC staff's conclusions stated in the ISR letter and also summarized and documented the results of the audit performed.

By letter dated July 24, 2017 (ADAMS Accession No. ML17205A336), FirstEnergy Nuclear Operating Company (FENOC, the licensee) submitted its MSA for Perry. The MSA is intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. As stated in the MSA, additional analyses performed by FENOC after issuance of the ISR letter resulted in revisions to the hazards, and are documented in Revision 2 to the FHRR. The changes reflected in Revision 2 of the FHRR are described in Section 3.6 and Section 4 of this document. The revisions to the mechanisms listed as not bounded by the CDB are also summarized in the MSA submittal, and are used as the basis to evaluate the adequacy of existing FLEX strategies at Perry. As a result of the evaluation performed, FENOC concluded that the FLEX strategies at the Perry site are adequate and that they can be implemented, as designed, without any impact.

This evaluation will document the adequacy of the revised hazards to be used as an input for the MSA and subsequent flooding evaluations. It will also evaluate the adequacy of the FLEX strategies at Perry in order to confirm that, if appropriately implemented, they are reasonably protected from reevaluated flood hazard conditions.

3.0 TECHNICAL EVALUATION

3.1 Mitigating Strategies under Order EA-12-049

By letter dated February 27, 2013 (ADAMS Accession No. ML13064A243), FENOC submitted its Overall Integrated Plan (OIP) for Perry in response to Order EA-12-049. By letter dated August 20, 2015 (ADAMS Accession No. ML15362A497), the licensee reported that full compliance with the requirements of Order EA-12-049 had been achieved, and submitted a Final Integrated Plan (FIP). FENOC submitted a revised FIP by letter dated February 3, 2016 (ADAMS Accession No. ML16036A310). By letter dated May 16, 2016 (ADAMS Accession No. ML16056A560), the NRC staff issued a safety evaluation documenting the results of the NRC

staff's review of the FLEX strategies for Perry. The safety evaluation concluded that the integrated plan, if implemented as described, should adequately address the requirements of Order EA-12-049.

Perry (Unit 1) is a General Electric boiling-water reactor (BWR) Model 6 with a Mark III containment. A second unit at the site (Unit 2) was originally planned and was partially constructed; however, it was never completed. References to Unit 2 structures, systems and components (SSCs) reflect the licensee's use of such pre-existing SSCs within their overall FLEX strategy for Unit 1.

Consistent with the requirements of Order EA-12-049, the licensee's mitigating strategy for beyond-design-basis external events response is divided into three phases. In general, the first phase is to initially cope by relying on installed plant equipment, the second phase is to transition from installed plant equipment to the on-site FLEX equipment, and the third phase is to obtain additional capability and redundancy from off-site equipment.

A brief summary of Perry's FLEX strategies are listed below:

- At the onset of an extended loss of alternating current (ac) power (ELAP), the reactor trips and the main condenser is unavailable due to the loss of circulating water. Decay heat is removed when the safety relief valves (SRVs) open on high pressure and dump steam from the reactor pressure vessel (RPV) to the Suppression Pool. In this initial phase (Phase 1) all of the core decay heat and RPV sensible heat is deposited to the Suppression Pool. Make-up to the RPV is provided by the reactor core isolation cooling (RCIC) turbine-driven pump, taking suction from the Condensate Storage Tank (CST) if available, or from the Suppression Pool if the CST is not available. Operators use the SRVs to perform a controlled cooldown and depressurization of the reactor.

- During Phase 2, RPV makeup continues via RCIC operation and heated water is pumped from the Suppression Pool to the Residual Heat Removal (RHR) system heat exchangers and back to the Suppression Pool using either the Suppression Pool Clean-Up (SPCU) or Alternate Decay Heat Removal (ADHR) pump (repowered by FLEX generator(s)). The RHR heat exchangers are cooled by water from a FLEX pump located in the Emergency Service Water (ESW) Pump House (ESWPH) taking a suction from Lake Erie, the ultimate heat sink (UHS) for the plant. This pump takes suction on the ESWPH Suction Bay via the Unit 2 ESW pump pedestal foundation and provides 2500 to 3000 gallons per minute (gpm) flow into the ESW system. Additional RCIC coping time may be achieved by dumping the Upper Containment Pool to the Suppression Pool. In the event that the CST is not available and the Suppression Pool cannot be maintained less than 185 degrees Fahrenheit (°F), a hose connection is provided on the RCIC suction. This allows the RCIC suction to be connected to an alternate source of makeup water.

- Phase 3 strategies are intended to result in indefinite coping with respect to the required key safety functions. During Phase 3, additional National SAFER [Strategic Alliance of FLEX Emergency Response] Response Center (NSRC) 4160 volt (V) ac (Vac) generators will be connected to the distribution center located in the FLEX Equipment Bay 1 (Diesel Generator Building) to supply additional electrical capacity. This additional capacity will allow the start of an

RHR pump for use in Suppression Pool Cooling or Shutdown Cooling (SDC) modes of operation.

- To maintain spent fuel pool (SFP) cooling capabilities, the required action is to establish the water injection lineup before the SFP operating deck environment degrades due to boiling in the pool. The pool will initially heat up due to the unavailability of the normal cooling system. The licensee has calculated that for the normal pool heat load, boiling could start at about 11 hours after the start of the ELAP. To assist ventilation and prevent over-pressurizing the fuel handling building (FHB), doors from the FHB to the outside on the east side of the plant will be opened prior to boiling.

- As stated, Perry has a Mark III containment. During Phase 1, normal design features of the containment, combined with closure of three manual valves, maintains containment integrity. Containment heat removal and hydrogen igniter operation are not possible during Phase 1 since they both rely on the availability of ac power, which is provided in Phase 2. During Phase 2, active cooling of the Suppression Pool will begin. Containment integrity is maintained by keeping containment atmospheric pressure less than the design limit of 15 pounds per square inch gauge.

3.2 Evaluation of Current FLEX Strategies Against Reevaluated Hazard(s)

The licensee has assessed the potential impacts of the revised LIP, streams and rivers, and storm surge flooding mechanisms, against the mitigating strategies designed to meet Order EA-12-049. The purpose of the MSA is to determine: (1) if the licensee's mitigating strategies are adequate as originally developed for Order EA-12-049 compliance, (2) if the licensee's mitigating strategies need to be modified, or (3) whether new mitigating strategies need to be developed to address the revised hazard exceedances.

As part of its MSA review, the NRC staff sought to understand if the reevaluated hazards impacted any of the FLEX storage location(s), any staging areas, haul paths, connection points, activities, timelines, etc. The NRC staff also reviewed the flood hazard elevations in the MSA in order to confirm if the elevations matched the values provided in the NRC's ISR letter for the applicable non-bounded mechanisms. In addition, the NRC staff previously issued a generic audit plan by letter dated December 5, 2016 (ADAMS Accession No. ML16259A189), that described the NRC staff's intention to conduct audits related to MSAs, as needed. The NRC staff has reviewed the information presented in the MSA, as well as supporting documentation. This included:

- Review of licensing documents and previous NTTF flooding submittals;
- Review of the topographical features of the site; and
- Review and documentation of existing mitigating strategies under Order EA-12-049.

Overall, the licensee determined in its evaluation that the revised streams and rivers and storm surge flooding mechanisms do not impact the site and therefore, the current FLEX strategies can be deployed with no substantial modifications in order to account for the reevaluated hazards. For the LIP event, the licensee plans plant modifications, as described in Section 3.5 of this evaluation. The complete details of the licensee's evaluation and the NRC staff's review are described below.

The NRC staff notes that the Perry Local datum is originally based on and within the tolerance levels of the National Geodetic Vertical Datum of 1929 (NGVD29). However, FENOC established a plant-specific datum for Perry, referred to as the "Perry Local Datum" (PLD) that was used in the calculations and is representative of building elevations. As a result, NGVD29 and PLD are slightly different (NGVD29 + 0.21 feet = PLD). Conversely, PLD - 0.21 feet = NGVD29. The NRC staff notes that unless otherwise stated, all elevations in this assessment are provided relative to NGVD29, consistent with the ISR letter.

3.3 Summary of Mitigating Strategies Assessment for Storm Surge

The ISR letter for Perry lists a storm surge level of 581.9 feet, with an associated wave/runup component of 27.6 feet, resulting in a maximum wave runup elevation of 609.5 feet. The licensee's MSA submittal, based on a subsequent revision of the FHRR, specifies a stillwater surge elevation of 582.8 feet with a maximum wave runup elevation of 609.5 feet. In either case, the maximum storm surge level, considering wind and wave effects, remains well below the site grade of 620 feet.

In its MSA, the licensee stated that the FLEX strategies (as described in the FIP) are minimally impacted as a result of a reevaluated storm surge event given that the Powerblock area is not inundated. The licensee's MSA also states that the storm surge stillwater elevation of 582.8 feet is below the ESWPH operating floor which is at elevation 586.5 feet.

The NRC staff reviewed the information provided in the MSA and agrees that, based on a site grade elevation of 620 feet, the reevaluated storm surge flood mechanism of 609.5 feet is not expected to have any inundation impact on the site Powerblock area. Therefore the FLEX activities that must be performed at locations on the site grade would not be impacted. Regarding the ESWPH, the NRC staff notes that the building entry elevation of 620.5 feet would not be impacted by the storm surge wind wave effects. There are mitigating strategies activities that must be performed within the ESWPH at the operating floor elevation of 586.5 feet. Since the ESWPH is hydraulically connected to Lake Erie via the intake tunnels, the NRC staff agrees with the licensee that the storm surge stillwater elevation (not the elevation with wind and waves) would determine the water level inside the building, and since it remains below the ESWPH operating floor, those activities would not be adversely impacted by the storm surge lake elevation.

The NRC staff described the storage and staging of FLEX equipment in the FLEX safety evaluation. The inside of the ESWPH, where the FLEX Lake Water pumps are stored and pre-staged would be protected from the storm surge elevation as previously described. The other onsite FLEX equipment is stored in existing robust structures with floors/entrances at an elevation of 620.5 feet, well above the reevaluated hazard level for this flooding mechanism. As a result of the above analysis, the NRC staff agrees that storage and staging of FLEX equipment is not expected to be adversely impacted by the reevaluated storm surge hazard.

With regards to other sources of potential water ingress, the staff notes that the ESWPH is designed to preclude ground water in-leakage with sealed penetrations. Any incidental in-leakage from ground water or system failures would be drained below the 586.5 foot floor level by grating openings above the suction bay of the pump house and back to the lake via the intake structure. As a result of the above analysis, the NRC staff agrees that the FLEX strategy would not be adversely impacted by the reevaluated storm surge hazard.

As part of the revised storm surge analysis, the licensee analyzed potential low water conditions in addition to the high water conditions. This was not specified in the ISR letter but the licensee included a discussion of this potential condition in their MSA. Specifically, the reevaluated low water level of 563.2 feet was below the original 565.26 foot elevation specified in the original design for the FLEX lake water pumps. As part of the MSA review, the licensee confirmed that the FLEX lake water pumps could safely operate at a minimum lake level of 563.0 feet and documented its evaluation in NORM-LP-7321, "Perry Nuclear Power Plant Flooding Mitigating Strategy Assessment Support Document". Specifically, Attachment 3 of this document provides the pump vendor's information, and shows the FLEX pumps to be able to fully operate under the lower water condition. As a result, FENOC confirmed the operability specifications of the FLEX lake water pump with the new lower water conditions.

In SECY-16-0074, "Assessment of Fukushima Tier 2 Recommendation Related to Evaluation of Natural Hazards other than Seismic and Flooding" (ADAMS Accession Nos. ML16102A301 and ML16102A303), the NRC staff evaluated potential low water conditions as a Tier 2 Fukushima activity pursuant to Section 402 of Public Law 112-074, "Consolidated Appropriations Act, 2012." This law specified that the NRC require licensees to reevaluate the seismic, tsunami, flooding, and other external hazards at their sites against current applicable Commission requirements and guidance. In the evaluation of other external hazards contained in SECY-16-0074, the NRC staff reviewed potential low water conditions at sites such as Perry located along the Great Lakes and concluded that further assessments of low water conditions were not warranted. Based on the information provided in the Perry MSA submittal, the NRC staff finds that the conclusions of SECY-16-0074 remain valid regarding potential low water conditions at Perry.

As a result of the above review, the NRC staff finds that the licensee has developed an appropriate response strategy to ensure that the FLEX response at Perry can be implemented with due consideration of the storm surge reevaluated hazard. Additional details regarding the review of associated effects (AEs) and flood event duration (FED) associated with these mechanisms is provided in Section 3.6 of this document.

3.4 Summary of Mitigating Strategies Assessment for Streams and Rivers

In its MSA, the licensee stated that the FLEX strategies (as described in the FIP) are minimally impacted as a result of a reevaluated streams and rivers event given that the Powerblock area is not inundated. As part of the analysis, the licensee analyzed the flooding effects on the site access road, which is expected to be inundated and therefore inaccessible, thus restricting off-site resources reaching the site for a short period. However, the licensee also stated that sufficient margin exists in the FLEX timeline that would allow for the short delay (approximately 2.5 hours until waters have receded) and therefore have no impact in the overall strategy.

The NRC staff has reviewed the information provided in the MSA and the supporting documentation related to streams and rivers. Based on an ongoing effort by FENOC to reconstitute the flooding design basis at Perry, the NRC staff notes that the licensee has modified the site and installed a Diversion Stream, which is located east-northeast of the site adjacent to the Unit 1 and 2 Cooling Towers. The Minor Stream, also located east-northeast of the site, was a significant flooding contributor prior to the site modifications. The Diversion Stream now diverts the Minor Stream contributions directly into Lake Erie, therefore reducing flooding conditions at the site. The remnants of the Minor Stream are now modeled as part of the LIP domain, and analyses show that the Powerblock is not impacted by offsite/stream and river flooding as a result of these modifications. The technical adequacy and evaluation of

these hazards has been performed and evaluated by the NRC staff in the FHRR staff assessment dated January 24, 2018, and in Sections 3.5 and 3.6 of this document. As a result of these modifications, the NRC staff agrees that, based on a site grade elevation of 620 feet, the reevaluated streams and rivers flood causing mechanism of 629.2 feet (Diversion Stream) is not expected to impact the Powerblock.

According to the licensee, the only impact from flooding of the Major Stream is that the site access road can be flooded, thus temporarily restricting passage of offsite resources such as personnel and equipment. In its MSA, the licensee noted that the total flood duration of the site access road is 2.5 hours, and that this would not adversely impact the mitigating strategy based on margin available in the timing of the overall strategy.

The NRC staff had previously reviewed Table C.1-1 "Timing and Deployment Timeline for Modes 1-4" of the FIP and documented its conclusions in the FLEX safety evaluation dated May 16, 2016. In this timeline, Phase 1 and Phase 2 FLEX activities begin at the onset of an ELAP event and are continually implemented for the first 13 hours. During this period, several activities will be performed, none requiring the use of the impacted section of the access road. Therefore, when comparing the total flood duration of the site access road against the FLEX activity timeline, the NRC staff agrees that there is adequate margin such that Phase 1 and Phase 2 FLEX activities can be performed. The NRC staff also concludes that the Phase 3 NSRC equipment, which is expected to arrive at the site approximately 24 hours after the ELAP event, can be deployed since its arrival is well beyond the timeframe where the site access road would be flooded. In addition, the NRC staff notes that the licensee's Phase 3 plan includes a contingency for the use of helicopters to access the site if flooding were to significantly damage the access road.

As a result of the above review, the NRC staff finds that the licensee has developed an appropriate response strategy to ensure that the FLEX response at Perry can be implemented with due consideration of the streams and rivers reevaluated hazard. Additional details regarding the review of AEs and FED associated with these mechanisms is provided in Section 3.6 of this document.

3.5 Summary of Mitigating Strategies Assessment for Local Intense Precipitation

In its MSA, the licensee stated that the FLEX strategies (as described in the FIP) would potentially be impacted given that the water surface elevation (WSE) would inundate the Powerblock area. The inundation of the Powerblock could potentially pose challenges for the implementation of FLEX strategies due to flooding of the deployment paths and staging areas, in addition to water levels above critical doors that are important for FLEX strategies.

As stated in the MSA, FENOC is in the process of reconstituting the flooding design basis at Perry, which includes the LIP event. The licensee is crediting modifications, taken or planned at the site, in order to conclude that the reevaluated hazards have no impact on the FLEX strategies. The design basis reconstitution is expected to utilize a time-based warning protection scheme in which incorporated barriers and specific trigger points will be required. Specifically, some of the actions being tracked in the corrective action program (CAP) and planned for implementation at Perry include, but are not limited to:

- For doors required for FLEX activities, installing flood protection barriers with the intended function of preventing flood waters to enter the buildings,

- Establishing and implementing a warning time and trigger point for the installation of flood barriers,
- Developing a proceduralized plan and pre-stage materials for flood barriers that are to be installed on Powerblock doors and openings,
- Completing Powerblock building flood protections and/or modifications, as necessary,
- Implementing flood protection features for the diesel generator fuel tank flame arrestors,
- Developing preventive maintenance documents for the Diversion Stream berm inspection, stream debris clearing and maintenance of ground cover overgrowth, and inspection of the site storm sewer system.

In summary, the licensee concluded in its MSA that the proposed changes to the Perry site, as described above, would prevent LIP from impacting the site and allow the FLEX strategies to be implemented as described in the FIP. With regards to the establishment and implementation of a warning time period, the NRC staff notes that NEI 15-05 "Warning Time for Local Intense Precipitation Events" (ADAMS Accession No. ML18005A076) was originally a white paper titled "Warning Time for Maximum Precipitation Events," dated April 8, 2015 (ADAMS Accession No. ML15104A157). This white paper was endorsed by the NRC by letter dated April 23, 2016 (ADAMS Accession No. ML15110A080), and subsequently issued as NEI 15-05 on May 1, 2015. Thus, the staff would consider the use of NEI 15-05, as endorsed, to be an acceptable way for FENOC to establish and implement a warning time for the LIP event at Perry.

Because FENOC is in the process of reconstituting the flooding design-basis at the site and the implementation of the proposed modifications is ongoing, the NRC staff was not able to review the specific details for this assessment. However, based on the licensee's description of the planned activities, the staff concludes that, if implemented as described, the strategies appear reasonable and should allow FLEX strategies to be implemented.

By letter dated April 2, 2018 (ADAMS Accession No. ML18094A661), the licensee notified the NRC that it had filed a voluntary petition for bankruptcy relief under Chapter 11 of Title 11 of the United States Code in the U.S Bankruptcy Court, Northern District of Ohio. Consistent with 10 CFR 50.82 (a)(1), FENOC notified the NRC by letter dated April 25, 2018 (ADAMS Accession No. ML18115A007) its decision to permanently cease operations at the Perry site by May 31, 2021.

The NRC staff notes that in SECY-16-0142, "Draft Final Rule-Mitigation of Beyond-Design-Basis Events," dated December 15, 2016 (ADAMS Accession No. ML16301A005), the staff proposed a requirement that licensees for operating nuclear power plants address the reevaluated seismic and flood hazards, which are considered beyond-design-basis events, within their mitigating strategies. The proposed implementation date of the MBDBE rule for a Mark III boiling-water reactor like Perry is 2 years after the Commission approves the rule. Should the Commission decide to issue the MBDBE rule, the licensee would need to comply with any applicable requirements or seek an appropriate exemption. Finally, the NRC staff notes that the completion of the proposed activities described in the MSA regarding LIP may be subject to regulatory oversight as part of the Reactor Oversight Process and any long-term inspections in support of the proposed Mitigation of MBDBE rulemaking.

3.6 Evaluation of the Flood Hazard Elevations in the Mitigating Strategies Assessment

Local Intense Precipitation and Associated Drainage

The licensee updated the maximum LIP water levels from 621.3 feet in the ISR letter to 621.65 feet in the MSA due to the change of the LIP model configuration. As reported in the MSA and the subsequent audit session conducted on January 17, 2018, the reported value of LIP flood

level represents the highest predicted flood WSE at plant doors which either lead into safety-related buildings or into non-safety-related areas which communicate with safety-related buildings. Additional details regarding the audit performed are described in Section 4 of this document. The licensee also indicated that there were five postulated scenarios of LIP temporal-peak-loading under consideration in the analysis; however, the one selected for the final analysis is the end-peak-loaded distribution since it produces more conservative flood levels when compared to other scenarios. The NRC staff's confirmatory analysis of the FLO-2D model indicated that there are locations where the WSEs were higher than the reported maximum WSE value for the LIP flooding. In response to the NRC staff's request during the audit, the licensee stated that other plant structures may experience higher WSEs at doorways, but that these buildings are not important to the implementation of FLEX strategies and do not have the potential to impact the FLEX strategies.

The licensee stated that for the LIP flood causing mechanism, the WSE inundates the Powerblock area and poses challenges for FLEX as a result of flooding of the deployment paths, staging areas, and water levels above critical doors which are important for implementing the FLEX strategies. However, the installation of door flood barriers and alternative deployment paths available will make it possible for the implementation of the FLEX strategies. The licensee used FLO-2D Pro software (FLO-2D, 2013: Build 16.06.16 which incorporates the Storm Water Management Model [SWMM] 5.0.022) to determine the maximum WSEs and flood depths for the LIP event at critical door locations. Figure 3.6.2 presents the FLO-2D confirmatory analysis LIP flooding maximum WSE and inundation area, while Figure 3.6.3 presents the inundation area details resulting from the Minor Stream and LIP with fetch lengths. The licensee stated in its MSA that the fetch lengths are insignificant to the result in wave runup. The NRC staff performed a confirmatory modeling of the LIP flooding mechanism using data obtained from the licensee as part of the audit, the FLO-2D modeling software, and present day guidance and methodologies. The confirmatory modeling was performed to verify the licensee's modeling parameters and consistency of the reported WSEs. Based on its review of information provided by the licensee, the NRC staff confirmed that the results of staff's confirmatory modeling for WSEs are consistent with the values stated in the MSA report, and the supporting information reviewed as part of the audit. Therefore, the NRC staff determined that the reported changes in the simulated LIP flood elevation values (summarized in Table 3.6-1) are inconsequential, and that the updated flood levels provided in the MSA are acceptable for use in the evaluation of FLEX strategies.

Streams and Rivers

The licensee reported that the streams and rivers flooding value of 628.5 feet in its MSA is consistent with the ISR letter for the Major Stream. In its MSA, the licensee described that part of what was previously identified as the Minor Stream has been removed, and instead a Diversion Stream has been constructed in order to divert the water away from the Minor Stream and directly into Lake Erie. As a result of these site modifications, the revised flood level for the Diversion Stream was reported as 629.2 feet and the post-modification site configuration is presented in Figure 3.6.1. After the construction of the Diversion Stream, the remnant of the Minor Stream was modeled as part of the LIP flooding model domain. Finally, the licensee stated that the analyses for the streams and rivers flooding show that this flood-causing mechanism does not contribute to onsite inundation, but could inundate the site access road.

Based on the above analysis and after an independent review, the NRC staff agrees that the changes performed by the licensee were adequately modeled to address site changes, and also

agrees that this flood-causing mechanism does not contribute to onsite inundation in a way that impacts the FLEX strategies at the site.

Probable Maximum Storm Surge

In the ISR letter, the probable maximum storm surge (PMSS) flood levels were evaluated with the addition of wave runup for the resulting in 609.5 feet at a location east of the Powerblock. However, in its MSA the licensee described that the observation locations of the PMSS flooding had been revised from the eastern side of the Powerblock to the western side of the Powerblock along the shoreline bluff slopes. The MSA reports that the maximum flood level east of the Powerblock with wind wave runup is still 609.5 feet, whereas the additional locations have stillwater elevations of 582.8 and 563.2 feet for high water and low water west of the Powerblock, respectively. The licensee identified a minor numerical rounding error with regards to the wave runup east of the Powerblock which was originally reported to be 27.6 feet and has changed to 27.5 feet in the MSA. The licensee also stated in its MSA that the two storm surge observation locations west of the Powerblock are not nearly as steep as the rest of the shoreline, and as a result they do not have the potential to generate appreciable wave runup.

Because the PMSS does not affect Perry due to the site location (on a bluff overlooking Lake Erie at an elevation higher than the water surface by approximately 40 feet), the NRC staff concluded that the PMSS flood hazard does not have the potential to flood the site and additional analyses are not warranted.

3.6.1 Evaluation of Flood Event Duration

The NRC staff reviewed information provided by FENOC regarding the FED parameters needed to perform the MSA for flood hazards not bounded by the CDB. The FED parameters for the flood-causing mechanisms not bounded by the CDB are summarized in Table 3.6-3 and the FED parameters are warning time or site preparation time, duration of inundation, and period of recession.

Local Intense Precipitation and Associated Drainage

The licensee used the results of the FLO-2D model to determine the FED parameters at critical door locations for the LIP flood-causing mechanism. In its MSA, the licensee stated that the durations of site inundation for the LIP flooding range between 1 and 2 hours depending on the location. The licensee provided a warning time of greater than 24 hours and stated in its MSA that for continued operation the site has established a trigger point based on predicted rainfall rates. The licensee stated that the warning time provided will be estimated to ensure it exceeds the site preparation time and that automatic notifications from fleet meteorologists will be the basis to commence site preparation actions. The licensee also stated in its MSA that a warning time will be established that will provide sufficient time for the onsite personnel to ensure doors/hatches are closed and flood barriers installed to prevent water ingress into the safety-related buildings.

The NRC staff confirmed that the licensee's reevaluation of the inundation periods for LIP and associated drainage uses present-day methodologies and regulatory guidance. As previously stated, although the licensee did not provide a validated warning time in its MSA, the NRC staff notes that the licensee could use the guidelines provided by NEI 15-05 (ADAMS Accession No. ML15104A158) in order to determine a more realistic LIP warning time (as needed) for its focused evaluation.

Guidance document NEI 16-05, Rev. 1 (ADAMS Accession No. ML16309A156) defines the period of recession for LIP as the period from when floodwaters drop below a penetration (or door threshold) elevation and drains from the site; to the complete recession of onsite flood level enough to return to the normal plant operation mode. The licensee reported in its MSA that the period of LIP flood recession is approximately 2 hours.

Based on the NRC staff's review of the licensee's MSA, including the information expanded upon and clarified during the audit, the staff concluded that the licensee's period of recession for the LIP flood-causing mechanism is acceptable for use in the MSA.

Streams and Rivers

The licensee has stated that the streams and rivers flooding mechanism does not inundate the site, but it can inundate the site access road. Correspondingly, the licensee reported in its MSA that the periods of inundation and recessions were 1 hour and 1.5 hours, respectively, at the site access road. Figure 3.6.4 presents the combined effects inundation area of the Major Stream.

The NRC staff reviewed the licensee's information regarding the streams and rivers flood-causing mechanism, and the concluded that the licensee's approach to determine the FED parameters is consistent with the guidance provided by Appendix G of NEI 12-06, Revision 2. Based on this review, the NRC staff concludes that the licensee's FED parameters are reasonable and acceptable for use in the MSA.

Probable Maximum Storm Surge

For the storm surge flood-causing mechanism, the maximum WSE is 582.8 feet for the high water west of the Powerblock along the shoreline bluffs, and 563.2 feet for the low water. As stated in the MSA, the maximum WSE of 582.8 feet is below the site elevation of 620.5 feet, and also below the ESWPH operating floor which is at an elevation of 586.5 feet. As stated in the MSA, the maximum PMSS effects due to wind-wave activity occur at a location east of the Powerblock along a section of shoreline with steeper bluff slopes. The licensee stated that the PMSS maximum WSE with wave runup at this location is estimated to be 609.5 feet which is below the site elevation of 620.0 feet.

Based on the analyses presented in its MSA, the licensee stated that the PMSS does not affect the site due to its location on a bluff overlooking Lake Erie at an elevation higher than the water surface by approximately 40 feet. Therefore, the licensee concluded that the FED parameters for this flood-causing mechanism were not applicable.

The NRC staff reviewed the methodology used to determine the PMSS flood levels and determined that it is consistent with the methodology used in the FHRR and previously reviewed information by the NRC staff. Moreover, the NRC staff conducted an audit (as described in Section 4 of this document) with the licensee and clarified information relative to the locations of the PMSS flooding which were not in the FHRR, but were included in the MSA. The NRC staff determined that the technical analysis and the rationale are sufficient to address the staff's questions. Moreover, as stated in the MSA and confirmed with the NRC staff's analysis, the final flood level resulting from the PMSS is well below the plant grade and is not expected to result in inundation.

In summary, the NRC staff agrees with the licensee's conclusion related to determining the FED parameters, given that the approach is consistent with the guidance provided by Appendix G of NEI 12-06, Revision 2. Based on its review, the NRC staff concluded that the licensee's FED parameters are acceptable for use in the MSA.

3.6.2 Evaluation of Associated Effects

The NRC staff reviewed the information provided by FENOC regarding the reevaluated AE parameters for flood hazards not bounded by the CDB. The AE parameters related to WSE (i.e., stillwater elevation with wind waves and runup effects) were previously reviewed by NRC staff, and were transmitted to the licensee via the ISR letter. The AE parameters not directly associated with WSE are discussed below and are summarized in Table 3.6-4.

For the LIP flood-causing mechanism, the licensee stated in its MSA report that hydrostatic and hydrodynamic loads resulting from LIP flooding would be minimal due to the small inundation depths and low flow velocities. Moreover, the licensee stated that the underdrain system was designed to maintain groundwater below 590 feet, while plant structures were designed for hydrostatic forces up to elevation 618 feet. Therefore, the licensee stated (and NRC staff confirmed) that significant margin is available to accommodate potential hydrostatic forces resulting from groundwater ingress during the postulated LIP flooding event.

The licensee stated in its MSA that very little debris or sediment will be deposited due to the short duration of the LIP event and impermeable ground covers of concrete and/or asphalt materials surrounding the Powerblock area. Furthermore, the licensee stated that the lack of sources of tree debris in the surrounding area and low velocities of flood water impinging on structures are expected to result in only minimal debris loading.

The licensee determined that the AE parameters are not applicable for the streams and rivers flood-causing mechanism since this mechanism would not inundate the site. The licensee also determined that the storm surge flood-causing mechanism would not inundate the site; as a result, the licensee determined the AE parameters are also not applicable for this flood-causing mechanism. The NRC staff agrees with the licensee's conclusions related to these AE parameters as their approach to estimate the AE parameters is consistent with the guidance provided in Appendix G of NEI 12-06, Revision 2.

The NRC staff reviewed the licensee's MSA, as expanded upon and clarified during the audit, for the LIP, storm surge, and riverine flood-causing mechanisms. The staff confirmed the licensee's estimated inundation depths and flow velocities relevant to establish the AE parameters. Based on these reviews, the NRC staff concludes that the licensee's assessment of the AE parameters for LIP, streams and rivers, and storm surge flood-causing mechanisms are acceptable for use in the MSA.

4.0 AUDIT REPORT

By letter dated December 5, 2016 (ADAMS Accession No. ML16259A189), the NRC staff issued a generic audit plan that described the NRC staff's intention to conduct audits, as needed, related to MSAs and issue an audit report that summarizes and documents the NRC's regulatory audit of the licensee's MSA. As part of the evaluation of the Perry MSA, the NRC staff reviewed selected supporting documents via an electronic reading room. The additional information consisted of the following reference documents:

- FENOC, 2018, Supplemental Information Need Request for Perry Unit 1 MSA: LIP Flooding Hazard Analysis Responses.
- FENOC, 2017b, Perry Nuclear Power Plant Flooding Mitigating Strategy Assessment Support Document (NORM-LP-7321) (Document Date: July 19, 2017). Attachment 5: PNPP Flood Hazard reevaluation Report, Revision 2.
- FENOC, 2017c, Supplemental Information Need Request and Responses Regarding the PNPP Mitigating Strategies Assessment for the Perry Nuclear Power Plant.
- Calculation 50:66.000, Revision 1: PNPP Site Modifications Local Intense Precipitation.
- Calculation 50:33.000, Revision 1: PNPP Stream Modification PMF.

The NRC staff notes that it utilized relevant information from these calculation packages in order to perform its review; however, the staff concluded that the reference documents described above were found to only expand upon and clarify the information already provided in the MSA, and therefore docketing of these references is not required to establish the basis for the conclusions of this MSA assessment. Because this staff assessment appropriately summarizes the NRC staff's audit review of the supporting documentation, the NRC staff concludes that a separate audit summary report is not necessary, and that this document serves as the final audit report for the audit plan dated December 5, 2016.

5.0 CONCLUSION

The NRC staff has reviewed the information provided in the Perry MSA related to current FLEX strategies, as evaluated against the reevaluated flood hazard(s) described in Section 2 of this staff assessment, and found that:

- In its MSA, the licensee revised the flood hazards described in the ISR letter, as applicable, in a manner that is consistent with present day guidance and methodologies, and therefore are reasonable for use in the MSA evaluation of FLEX strategies;

- Impacts to the FLEX strategies as a result of streams and rivers, and storm surge have been adequately identified, and addressed;

- Impacts to the FLEX strategies as a result of LIP have been qualitatively analyzed and identified. The proposed changes and modifications to the site appear to be reasonable, and should protect FLEX strategies if appropriately implemented, as described;

- Phase 1, 2 and 3 activities are reasonably protected against the revised reevaluated hazards and are expected to be implemented, as described in the FIP and as described in the MSA by crediting proposed actions at the site.

Based on the above analysis, the NRC staff concludes that the licensee has demonstrated the capability to deploy the existing FLEX strategies against a postulated beyond-design-basis event for streams and rivers, and storm surge. For LIP, the licensee has described changes and modifications to the site that once implemented, appear to be reasonable and are expected to allow FLEX strategies to be implemented, as designed. The NRC staff also confirmed that the licensee's flood hazard MSA was performed consistent with the guidance in Appendix G of NEI 12-06, Revision 2, as endorsed by JLD-ISG-2012-01, Revision 1. Based on the licensee's appropriate hazard characterization, methodology used in the MSA evaluation, and the description of its strategy; the staff concludes that the licensee has demonstrated that the mitigation strategies, if appropriately implemented, are reasonably protected from reevaluated flood hazard conditions.

Table 3.6-1 Revised Flood Elevations in the MSA for Flood-Causing Mechanisms Not Bounded by the CDB.

Flood-Causing Mechanism	Stillwater Elevation (feet NGVD29)	Wave/Runup	Reevaluated Flood Hazard Elevation (feet NGVD29)
Local Intense Precipitation and Associated Drainage	621.65	N.A.	621.65
Streams and Rivers			
Major Stream	628.5	N.A.	628.5
Diversion Stream	629.2	N.A.	629.2
Storm Surge			
High Water: West of the Powerblock along the shoreline bluff slopes	582.8	N.A.	582.8
Low water	563.2	N.A.	563.2

Note: N.A. stands for Not Applicable

TABLE 3.6-2. Comparison of the Maximum WSEs for LIP between FHRR (Rev 1) and MSA (FHRR Rev 2) at Licensee-selected Points of Interests.

Building	Door No.	Maximum Water Surface Elevation (MWSE) (feet NGVD29)		Difference in MWSE, (1)-(2) (feet)
		MSA (FHRR Rev. 2) (1)	FHRR Rev 1 (2)	
U1 Auxiliary Building	1AX 406	621.10	620.60	0.50
U1 Auxiliary Building	1AX 404	621.11	620.62	0.49
U1 Auxiliary Building	1AX 403	621.13	620.66	0.47
U1 Auxiliary Building	1AX 407	621.25	620.69	0.56
U1 Auxiliary Building	1AX 405	621.25	620.69	0.56
U1 Turbine Building	1TB 307	621.25	620.67	0.58
U1 Turbine Building	1TB 316	621.08	620.55	0.53
U1 Heater Bay	1HB 310	620.91	620.45	0.46
U1 Heater Bay	1HB 311	620.73	620.38	0.35
U1 Heater Bay	1HB 309	620.93	620.51	0.42
U1 Heater Bay	1HB 308	621.08	620.55	0.53
U1 Turbine Power Complex	1TP 306	621.09	620.59	0.50
U1 Turbine Power Complex	1TP 303	621.25	620.69	0.56
U1 Off Gas Building	1OG 303	621.25	620.62	0.63

U1 Off Gas Building	1OG 302	621.25	620.62	0.63
U1 Off Gas Building	1OG 304	621.25	620.66	0.59
U1 Water Treatment Building	0WT 101	620.80	620.43	0.37
Water Treatment Building	0WT 103	621.16	620.64	0.52
Water Treatment Building	0WT 102	621.25	620.67	0.58
Diesel Generator Building	0DG 106	621.30	620.82	0.48
Diesel Generator Building	0DG 105	621.29	620.81	0.48
Diesel Generator Building	0DG 104	621.28	620.79	0.49
Diesel Generator Building	0DG 103	621.27	620.78	0.49
Diesel Generator Building	0DG 102	621.26	620.76	0.50
Diesel Generator Building	0DG 101	621.26	620.72	0.54
Radwaste Building	0RW 422	621.26	620.73	0.53
Radwaste Building	0RW 407	621.26	620.73	0.53
Radwaste Building	0RW 411	621.25	620.67	0.58
Radwaste Building	0RW 101	621.25	620.62	0.63
Intermediate Building	0IB 315	621.10	620.72	0.38
Intermediate Building	0IB 316	621.22	620.90	0.32
Intermediate Building	0IB 317	621.24	620.92	0.32
Service Building	0SB 113	621.34	620.88	0.46
Service Building	0SB 114	621.35	620.88	0.47
Service Building	0SB 107	621.35	620.89	0.46
Service Building	0SB 104	621.34	620.90	0.44
Service Building	0SB 105	621.35	620.93	0.42
Service Building	0SB 108	621.35	620.96	0.39
Service Building	0SB 103	621.34	620.96	0.38
Service Building	0SB 102	621.33	620.91	0.42
Service Building	0SB 101	621.31	620.84	0.47
U2 Auxiliary Building	2AX 403	621.33	620.98	0.35
U2 Auxiliary Building	2AX 404	621.40	621.01	0.39
U2 Auxiliary Building	2AX 406	621.45	621.02	0.43
U2 Auxiliary Building	2AX 405	621.35	620.87	0.48
U2 Auxiliary Building	2AX 407	621.34	620.88	0.46
U2 Turbine Building	2TB-E	621.50	621.07	0.43
U2 Turbine Building	2TB-D	621.50	621.07	0.43
U2 Turbine Building	2TB 316	621.64	621.30	0.34
U2 Turbine Building	2TB-C	621.65	621.33	0.32
U2 Turbine Building	2TB-B	621.40	621.09	0.31
U2 Turbine Building	2TB 308	621.41	621.09	0.32
U2 Turbine Building	2TB-A	621.35	621.04	0.31
U2 Turbine Building	2TB 307	621.35	621.03	0.32
U2 Heater Bay	2HB 303	621.65	621.34	0.31
U2 Heater Bay	2HB 306	621.44	621.18	0.26
U2 Turbine Power Complex	2TP 303	621.35	620.87	0.48
U2 Off Gas Building	2OG 304	621.35	621.01	0.34
U2 Off Gas Building	2OG 302	621.34	620.94	0.40

U2 Off Gas Building	2OG 303	621.34	620.94	0.40
Service Water Pump	SW 101	620.02	620.06	-0.04
ESWPH	EW 202	620.22	620.23	-0.01
ESWPH	EW 201	620.36	620.48	-0.12
ESWPH	EW East	620.47	620.48	-0.01
Circulating Water Pump	U2 CW 101	621.87	621.95	-0.08
Circulating Water Pump	U2 CW 102	621.87	621.96	-0.09

Note: The buildings and door numbers were selected by the licensee.

Table 3.6-3 Flood Event Durations for Flood-Causing Mechanisms Not Bounded by the CDB

Flood-Causing Mechanism	Time Available for Preparation for Flood Event	Duration of Inundation of Site	Time for Water to Recede from Site
Local Intense Precipitation and Associated Drainage	>24 hours	1 - 2 hours (approx.)	2 hours
Streams and Rivers	N.A.	Site access road 1 hour	Site access road 1.5 hour
Storm Surge [1]	N.A.	N.A.	N.A.

[1] The FED parameters for the storm surge flood-causing mechanism are not applicable because the plant site would not be inundated by these flooding mechanisms.
[2] N.A stands for not applicable.

TABLE 3.6-4 ASSOCIATED EFFECTS PARAMETERS NOT DIRECTLY ASSOCIATED WITH TOTAL WATER HEIGHT FOR FLOOD-CAUSING MECHANISMS NOT BOUNDED BY THE CDB

Associated Effects Parameter	Local Intense Precipitation and Associated Drainage	Streams and Rivers [1]	Storm Surge [1]
Hydrodynamic loading at plant grade	Minimal	N.A.[2]	N.A.
Debris loading at plant grade	Minimal	N.A.	N.A.
Sediment loading at plant grade	Minimal	N.A.	N.A.
Sediment deposition and erosion	Minimal	N.A.	N.A.
Concurrent conditions, including adverse weather - Winds	Minimal	N.A.	N.A.
Groundwater ingress	Minimal	N.A.	N.A.
Other pertinent factors (e.g., waterborne projectiles)	Minimal	N.A.	N.A.

[1] The AE parameters for the streams and rivers, and storm surge flood-causing mechanisms are not applicable because the plant site would not be inundated by these flooding mechanisms.

[2] N.A stands for not applicable.

Figure 3.6.1 Perry Nuclear Power Plant with proposed layout of site modifications. (Source: FENOC Audit –Licensee generated figure, See Section 4) (Source: Public Meeting held June 29, 2017 (ADAMS Accession No ML17193A419))

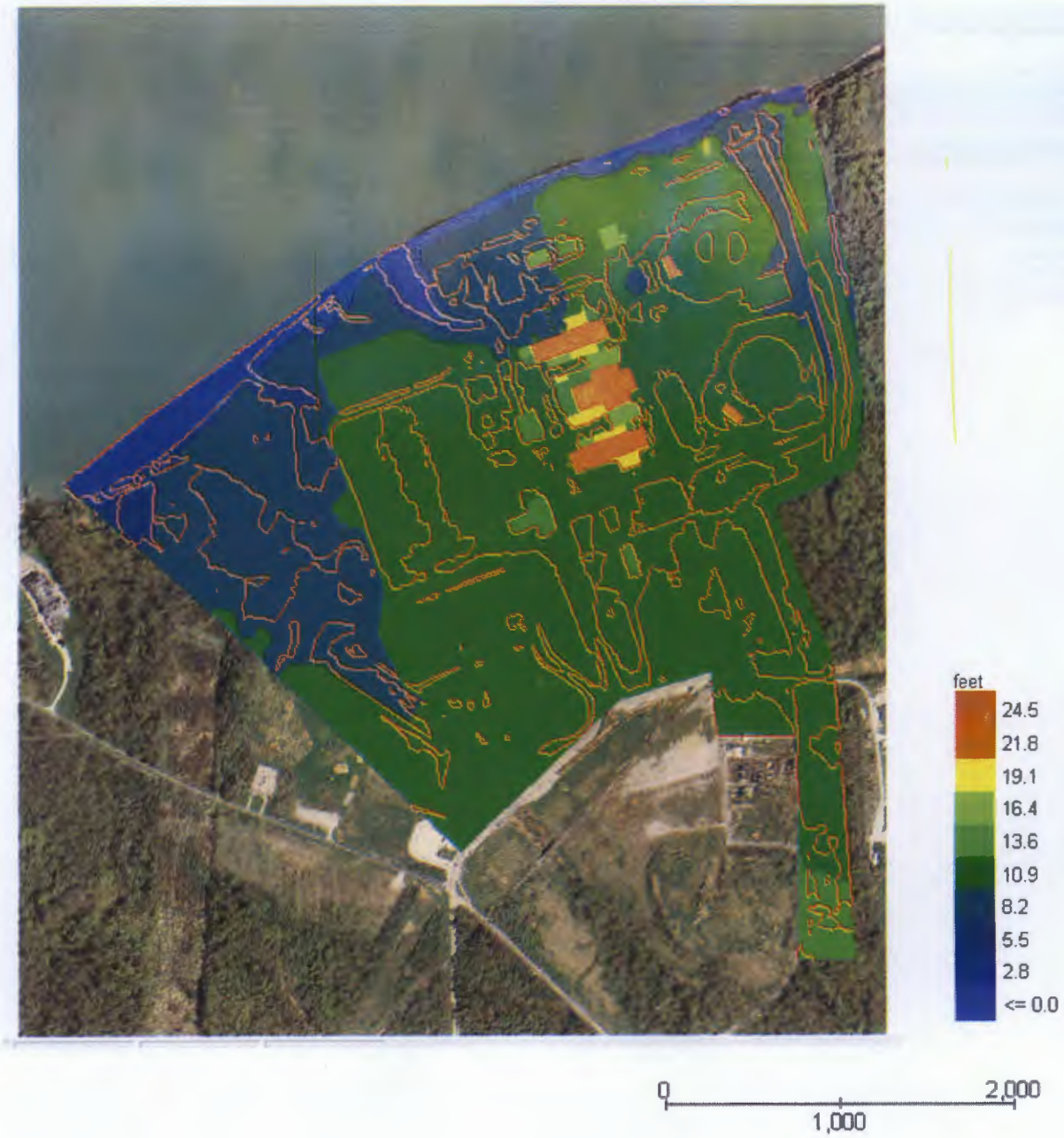

Figure 3.6.2 Perry Nuclear Power Plant with proposed layout of site modifications simulated by FLO-2D, including maximum WSEs (feet NGVD29 minus 600 feet) in color map with major Inundation Area in red line. (Source: NRC Staff independent confirmatory analysis using FLO-2D).

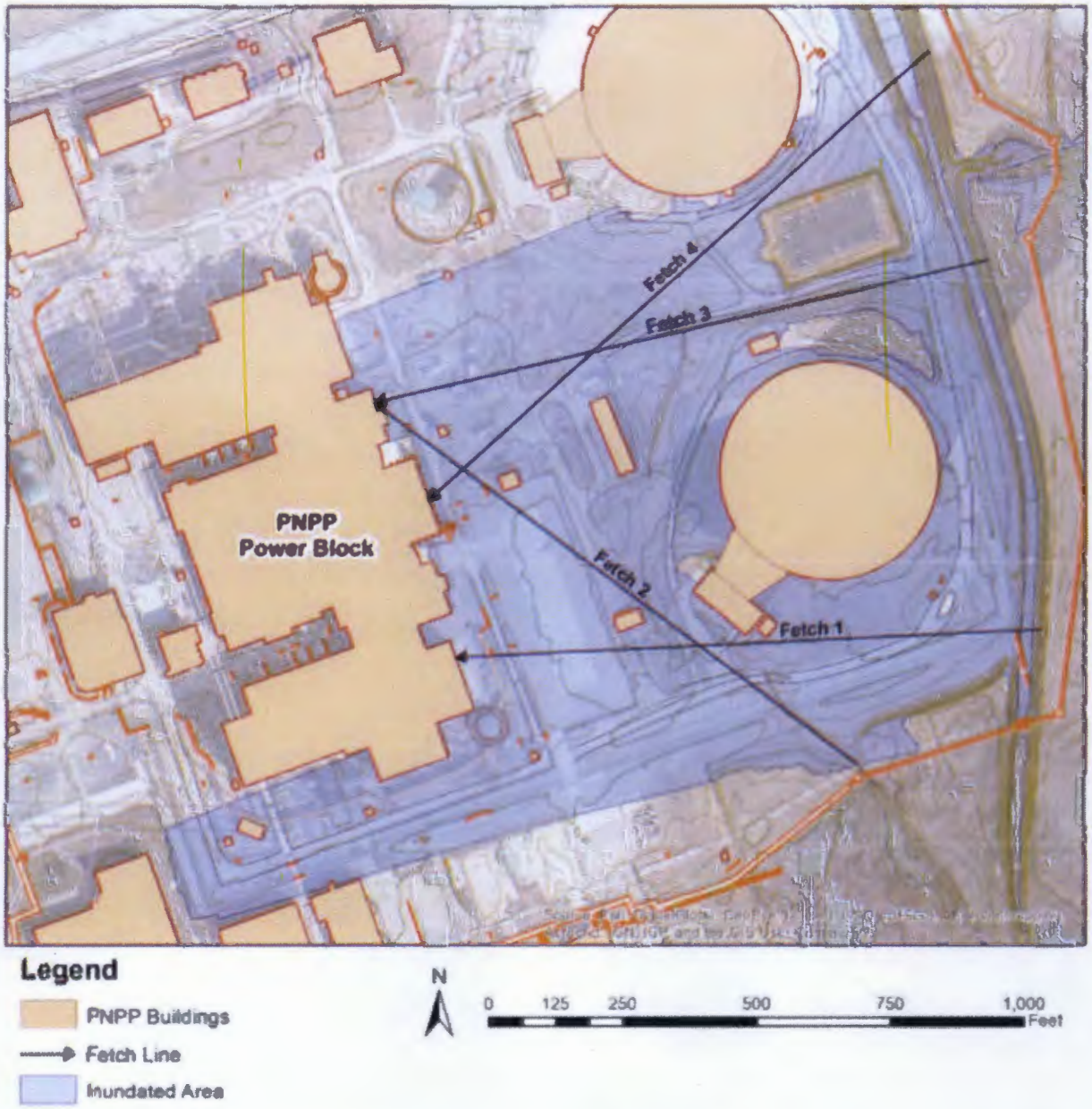

Figure 3.6.3 Perry Nuclear Power Plant Minor Stream (on the right side) Combined Effect Inundation Area (Source: FENOC Audit –Licensee generated figure. Used with approval. See Section 4).

[Note: The short duration of flooding, and the building/barriers around the areas of interest at the Perry Nuclear Power Plant site would not allow sufficient fetch length to develop, therefore wave runup becomes insignificant]

Figure 3.6.4 Perry Nuclear Power Plant Major Stream Combined Effect Inundation Area (Source: FENOC Audit –Licensee generated figure. Used with approval. See Section 4)

SUBJECT: PERRY NUCLEAR POWER PLANT UNIT 1 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NO. MF7960; EPID L-2016-JLD-0007) DATED May 3, 2018

DISTRIBUTION:

PUBLIC
PBMB R/F
RidsNrrDlp Resource
RidsNrrDorllpl3 Resource
RidsNrrDorl Resource
RidsNrrPMPerry Resource
RidsNrrLaSLent Resource
RidsOgcMailCenter Resource
RidsOpaMail Resource
RidsACRS_MailCTR Resource
RidsNroDsea Resource
RidsRgn3MailCenter Resource
CCook, NRO
HAhn, NRO
EBowman, NRR
NTiruneh, NRR
RRiveraLugo, NRO

ADAMS Accession No.: ML18108A694 ***concurrence via e-mail**

OFFICE	NRR/DLP/PBMB/PM	NRR/DLP/PBMB/LA	NRO/DSEA/RHM2*	NRO/DSEA/RHM2*
NAME	JUribe	SLent	HAhn	NTiruneh
DATE	4/18/2018	4/19/2018	4/12/2018	4/12/2018
OFFICE	NRR/DLP/PBMB/PM	NRO/DSEA/RHM2/BC*	NRR/DLP/PBMB/BC	NRR/DLP/PBMB/PM
NAME	PBamford	SDevlinGill	EBowman	JUribe
DATE	4/18/2018	4/12/2018	4/19/2018	5/3/18

OFFICIAL RECORD COPY