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

July 24, 2014

Mary G. Korsnick
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SUBJECT: NINE MILE POINT NUCLEAR STATION UNITS 1 AND 2 – STAFF ASSESSMENT OF RESPONSE TO 10 CFR 50.54(f) INFORMATION REQUEST – FLOOD-CAUSING MECHANISM REEVALUATION (TAC NOS. MF1104 AND MF1105)

Dear Ms. Korsnick:

By letter dated March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to 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 as part of implementing lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 2 to the 50.54(f) letter requested licensees to reevaluate flood-causing mechanisms using present-day methodologies and guidance.

By letters dated June 8, 2012, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12164A369), January 29, 2013 (ADAMS Accession No. ML13030A430), March 12, 2013 (ADAMS Accession No. ML130740943), August 1, 2013 (ADAMS Accession No. ML13214A383), September 6, 2013 (ADAMS Accession No. ML13254A151), December 19, 2013 (ADAMS Accession No. ML14006A003), and January 31, 2014 ADAMS Accession No. ML14038A122), Constellation Energy Nuclear Group, LLC responded to this request for Nine Mile Point Nuclear Station Units 1 & 2.

The NRC staff has reviewed the information provided and, as documented in the enclosed staff assessment, determined that sufficient information was provided in response to the 50.54(f) letter. However, the staff has identified two issues that resulted in action items. These action items are documented and explained in the attached staff assessment and will be addressed as part of the integrated assessment. Because the reevaluated flood-causing mechanism was not bounded by your current plant-specific design basis hazard, the NRC staff anticipates submittal of an Integrated Assessment in accordance with Enclosure 2, Required Response 3, of the 50.54(f) letter no more than 2 years from the date you submitted the Flood Hazard Reevaluation Report.

If there are any questions, please contact me at (301) 415-3733 or email at Robert.Kuntz@nrc.gov.

Sincerely,

Robert F. Kuntz, Senior Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos.: 50-220, and 50-410

Enclosures:
Staff Assessment of Flood Hazard Reevaluation Report

cc w/enclosures:

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO FLOODING HAZARD REEVALUATION REPORT

NEAR-TERM TASK FORCE RECOMMENDATION 2.3

RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT

NINE MILE POINT NUCLEAR STATION UNITS 1 & 2

DOCKET NOS. 50-220 AND 50-410

1.0 INTRODUCTION

By letter dated March 12, 2012 (NRC, 2012a), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) "Conditions of license" (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons-learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant as documented in the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (NRC, 2011b).[1] Recommendation 2.1 in that document recommended that the staff issue orders to all licensees to reevaluate seismic and flooding for their sites against current NRC requirements and guidance. Subsequent Staff Requirements Memoranda associated with Commission Papers SECY-11-0124 (NRC, 2011c) and SECY-11-0137 (NRC, 2011d), directed the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f).

Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits (ESPs) and combined licenses (COLs). The required response section of Enclosure 2 specified that NRC staff would provide a prioritization plan indicating Flooding Hazard Reevaluation Report (FHRR) deadlines for each plant. On May 11, 2012 the staff issued (NRC, 2012b) its prioritization of the FHRRs.

If the reevaluated hazard for any flood-causing mechanism is not bounded by the current plant design basis flood hazard, an Integrated Assessment will be necessary. The FHRR and the responses to the associated Requests for Additional Information (RAIs) will provide the hazard

[1] Issued as an enclosure to Commission Paper SECY-11-0093 (NRC, 2011a).

input necessary to complete the Integrated Assessment report as described in Japan Lessons Learned Project Directorate interim staff guidance JLD-ISG-2012-05, "Guidance for Performing the Integrated Assessment for External Flooding" (NRC, 2012c).

By letter dated March 12, 2013 (Spina, 2013), Constellation Energy Nuclear Group, LLC provided the FHRR for Nine Mile Point Nuclear Station (NMP) Units 1 & 2. The NRC staff issued a RAI to the licensee. The licensee responded to the RAI by letter dated December 19, 2013 (Korsnick, 2013). In connection with this response, the licensee identified certain interim actions. The licensee provided supplemental information on the current status of interim actions identified in the FHRR, Attachment 2, in a letter dated August 1, 2013 (Costanzo, 2013). The licensee stated in FHRR Section 4.4 that interim actions and procedures exist to ensure that the plant will be safe during a flood event, and that these interim actions and procedures will be reevaluated and updated as determined by the Integrated Assessment. Because a reevaluated flood-causing mechanism is not bounded by the current plant-specific design basis hazard, the staff anticipates submittal of an Integrated Assessment. The staff will prepare an additional staff assessment report to document its review of the Integrated Assessment.

The licensee submitted a separate flooding walkdown report associated Near-Term Task Force Recommendation 2.3 (Korsnick, 2012). The staff prepared a separate staff assessment report to document its review of the licensee's flooding walkdown report (NRC, 2014).

2.0 REGULATORY BACKGROUND

2.1 Applicable Regulatory Requirements

As stated above, Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for ESPs and COLs. This section describes present-day regulatory requirements that are applicable to the FHRR.

Section 50.34(a)(1), (a)(3), (a)(4), (b)(1), (b)(2), and (b)(4), of 10 CFR, describes the required content of the preliminary and final safety analysis reports, including a discussion of the facility site with a particular emphasis on the site evaluation factors identified in 10 CFR Part 100. The licensee should provide any pertinent information identified or developed since the submittal of the preliminary safety analysis report in the final safety analysis report.

Section 50.54(f) of 10 CFR states that a licensee shall at any time before expiration of its license, upon request of the Commission, submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked. The 50.54(f) letter of March 12, 2012 requested licensees reevaluate the flood-causing mechanisms for their respective sites using present-day methodologies and regulatory guidance used by the NRC for the ESP and COL reviews.

General Design Criterion 2 in Appendix A of Part 50 states that structures, systems, and components (SSCs) important to safety at nuclear power plants must be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their intended safety functions. The design bases for these SSCs are to reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. The design bases are also to have sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

Section 50.2 of 10 CFR defines the design basis as the information that identifies the specific functions that an SSC of a facility must perform, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design which each licensee is required to develop and maintain. These values may be (a) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (b) requirements derived from an analysis (based on calculation, experiments, or both) of the effects of a postulated accident for which an SSC must meet its functional goals.

Section 54.3 of 10 CFR defines the "current licensing basis" (CLB) as: "the set of NRC requirements applicable to a specific plant and a licensee's written commitments for ensuring compliance with and operation within applicable NRC requirements and the plant-specific design basis (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect." This includes 10 CFR Parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 52, 54, 55, 70, 72, 73, 100 and appendices thereto; orders; license conditions; exemptions; and technical specifications as well as the plant-specific design-basis information as documented in the most recent final safety analysis report. The licensee's commitments made in docketed licensing correspondence, which remain in effect, are also considered part of the CLB.

Present-day regulations for reactor site criteria (Subpart B to 10 CFR Part 100 for applications on or after January 10, 1997) state, in part, that the physical characteristics of the site must be evaluated and site parameters established such that potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site. Factors to be considered when evaluating sites include the nature and proximity of dams and other man-related hazards (10 CFR 100.20(b)) and the physical characteristics of the site, including the hydrology (10 CFR 100.21(d)).

2.2 Enclosure 2 to the 50.54(f) Letter

The 50.54(f) letter requests all power reactor licensees and construction permit holders reevaluate all external flood-causing mechanisms at each site. The reevaluation should apply present-day methods and regulatory guidance that are used by the NRC staff to conduct ESP and COL reviews. This includes current techniques, software, and methods used in present-day standard engineering practice. If the reevaluated flood-causing mechanisms are not bounded by the current plant design basis for flood hazard, an Integrated Assessment will be necessary.

2.2.1 Flood-Causing Mechanisms

Attachment 1 to Recommendation 2.1, Flooding (Enclosure 2 of the 50.54(f) letter) discusses flood-causing mechanisms for the licensee to address in the FHRR. Table 2.2-1 lists the flood-causing mechanisms the licensee should consider. Table 2.2-1 also lists the corresponding Standard Review Plan (SRP) (NRC, 2007) sections and applicable interim staff guidance documents containing acceptance criteria and review procedures. The licensee should incorporate and report associated effects per JLD-ISG-2012-05 (NRC, 2012c) in addition to the maximum water level associated with each flood-causing mechanism.

2.2.2 Associated Effects

In reevaluating the flood-causing mechanisms, the "flood height and associated effects" should be considered. JLD-ISG-2012-05 (NRC, 2012c) defines "flood height and associated effects" as the maximum stillwater surface elevation plus:

- wind waves and run-up effects
- hydrodynamic loading, including debris
- effects caused by sediment deposition and erosion
- concurrent site conditions, including adverse weather conditions
- groundwater ingress
- other pertinent factors

2.2.3 Combined Effect Flood

The worst flooding at a site that may result from a reasonable combination of individual flooding mechanisms is sometimes referred to as a "Combined Effect Flood." Even if some or all of these individual flood-causing mechanisms are less severe than their worst-case occurrence, their combination may still exceed the most severe flooding effects from the worst-case occurrence of any single mechanism described in the 50.54(f) letter (See SRP Section 2.4.2, Area of Review 9.(NRC, 2007)). Attachment 1 of the 50.54(f) letter describes the "Combined Effect Flood" [2] as defined in American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.8-1992 (ANSI/ANS, 1992) as follows:

> *For flood hazard associated with combined events, American Nuclear Society (ANS) 2.8-1992 provides guidance for combination of flood causing mechanisms for flood hazard at nuclear power reactor sites. In addition to those listed in the ANS guidance, additional plausible combined events should be considered on a site-specific basis and should be based on the impacts of other flood causing mechanisms and the location of the site.*

If two less severe mechanisms are plausibly combined (per ANSI/ANS-2.8-1992 (ANSI/ANS, 1992) and SRP (NRC, 2007) Section 2.4.2, Areas of Review 9), then the staff will document and report the result as part of one of the hazard sections. An example of a situation where this may occur is flooding at a riverine site located where the river enters the ocean. For this site, storm surge and river flooding should be plausibly combined.

2.2.4 Flood Event Duration

Flood event duration was defined in the Interim Staff Guidance (ISG) for the Integrated Assessment for external flooding, JLD-ISG-2012-05 (NRC, 2012c), as the length of time during which the flood event affects the site. It begins when conditions are met for entry into a flood

[2] For the purposes of this Staff Assessment, the terms "combined effects" and "combined events" are synonyms.

procedure, or with notification of an impending flood (e.g., a flood forecast or notification of dam failure), and includes preparation for the flood. It continues during the period of inundation, and ends when water recedes from the site and the plant reaches a safe and stable state that can be maintained indefinitely. Figure 2.2-1 illustrates flood event duration.

2.2.5 Actions Following the FHRR

For the sites where the reevaluated flood hazard is not bounded by the current design basis flood hazard for all flood-causing mechanisms, the 50.54(f) letter requests licensees and construction permit holders to:

- Submit an Interim Action Plan with the FHRR documenting actions planned or already taken to address the reevaluated hazard

- Perform an Integrated Assessment subsequent to the FHRR to: (a) evaluate the effectiveness of the current licensing basis (i.e., flood protection and mitigation systems); (b) identify plant-specific vulnerabilities; and (c) assess the effectiveness of existing or planned systems and procedures for protecting against and mitigating consequences of flooding for the flood event duration

If the reevaluated flood hazard is bounded by the current design basis flood hazard for all flood-causing mechanisms at the site, licensees are not required to perform an Integrated Assessment at this time.

3.0 TECHNICAL EVALUATION

The NRC staff reviewed the information provided for the flood hazard reevaluation of NMP Units 1 and 2. The licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance used by the NRC staff in connection with ESP and COL reviews. The staff's review and evaluation is provided below.

The site grade at the powerblock (e.g., all personnel entrances to Category I structures) is elevation 261 ft (79.6 m)[3] mean sea level ((MSL) on the United State Lake Survey Datum 1935 (USLS35)). Unless otherwise stated, all elevations in this staff assessment are given with respect to MSL on the USLS35 datum. Table 3.0-1 provides conversion factors between USLS35 and other commonly used datums in the site region. Table 3.0-2 provides the summary of controlling reevaluated flood-causing mechanisms, including associated effects, the licensee computed to be higher than the powerblock elevation.

3.1 Site Information

The 50.54(f) letter includes the SSCs important to safety, and the Ultimate Heat Sink (UHS), in the scope of the hazard reevaluation. Per the 50.54(f) letter, Enclosure 2, Requested

[3] The licensee's flood hazard reevaluation studies were conducted using customary units of measure. In this report, customary measurements are followed by the equivalent measurement in metric units. Because the conversion to metric units may involve loss of precision, the measurement in conventional units is definitive.

Information, Hazard Reevaluation Report, Item a, the licensee included pertinent data concerning these SSCs in the FHRR.

To provide additional information in support of the summaries and conclusions in the FHRR, the licensee made several calculation packages available to the staff via an electronic reading room. These calculation packages expand upon and clarify the information provided on the docket.

The staff requested additional information from the licensee to supplement the FHRR. The licensee provided this additional information by letter dated December 19, 2013 (Korsnick, 2013), which is discussed in the appropriate sections below.

The 50.54(f) letter, Enclosure 2 (Recommendation 2.1: Flooding), Requested Information, Item a, describes site information to be contained in the FHRR. The staff reviewed and summarized this information as follows.

3.1.1 Detailed Site Information

The licensee described in the FHRR the following site information related to the site flood hazard reevaluation. NMP Units 1 and 2 are located on the southeast shore of Lake Ontario, in Oswego County, NY. The site consists of approximately 900 acres (3.64 km^2) of partially wooded area. The original elevation of the site is between 256 ft (78.0 m) and 265 ft (80.8 m).

The licensee provided a detailed site layout and topography maps in the FHRR. The site is graded to carry onsite runoff to Lake Ontario. External barriers located on all three land sides of the plant site divert offsite runoff from the surrounding area to the site. The onsite floods are drained by the flood control berms and two outlets discharged to the north.

The lake shore is located approximately 200 ft (60 m) north from the nearest plant structures. The site is protected from potential flooding from the lake by the following features, starting from the shoreline to south: (1) a 1,000 ft (305 m) long shore protection dike which has a top elevation of 263 ft (80.2 m) and a top width of 50 ft (15.2 m); and (2) a revetment and interior drainage ditch adjacent to NMP Unit 2 at an elevation of 263 ft (80.2 m) and a width of 24 ft (7.3 m); (3) a ditch with elevations ranging from 254 ft (77.4 m) to 249 ft (75.9 m) to crush waves and direct flow back to the lake; and (4) a raised plant grade to at least elevation 260 ft (79.3 m) along the protected area security fence located about 80 ft (24.4 m) to 100 ft (30.5 m) away from the shoreline. Figure 3.1-1 shows the locations of the dike, revetment and interior drainage ditch relative to other structures.

Encompassing the site are two watersheds with small creeks, which flow into Lake Ontario. The licensee stated in the FHRR that the berms located on the east, west, and south of the plant physically separate these watersheds from the site. The Lake Road Culvert connects one of the watersheds to the plant south side. There are four other culverts along the main drainage system to discharge onsite runoff (see Figure 3.1-1).

3.1.2 Design Basis Flood Hazards

The design basis flood levels for NMP Units 1 and 2 are described in the Unit 1 Final Safety Analysis Report (FSAR) (UniStar Nuclear Energy, 2011) and Unit 2 Updated FSAR

(UFSAR)(UniStar Nuclear Energy, 2010). FHRR Table 3.3-1 summarizes the current licensing basis flood elevations, which are equivalent to the current design basis flood elevations in the latest versions of the FSARs. The following is a summary of the design basis flood hazards.

NMP Unit 1

The licensee stated in the FHRR that NMP Unit 1 was designed and built prior to the issuance of the SRP (NRC, 2007: originally published in 1975), and the FSAR for Unit 1 (UniStar Nuclear Energy, 2011) does not explicitly discuss design basis flood hazards. However, FHRR Section 1.4.3 states that the plant grade for NMP Unit 1 is at elevation 261 ft (79.6 m).

The individual plant evaluation for external events (IPEEE) (AREVA, 1996) utilized information from the Unit 2 UFSAR to show that the only flooding mechanism of concern for Unit 1 is an onsite probable maximum precipitation (PMP) event. Based on the Unit 2 analysis for the IPEEE, the licensee concluded that the local intense precipitation (LIP) flood height elevation resulting from an onsite PMP event is 261.75 ft (79.8 m). In this flood estimation, the licensee conservatively assumed that the storm water drainage system is inoperable (blocked), but that the culverts located southwest of the Unit 1 switchyard are not blocked so that runoff from this area could flow into the plant area. Section 3.2.1 of the FHRR describes elevation 261.75 ft (79.8 m) as the current licensing basis LIP flood event.

NMP Unit 2

The licensee estimated, in the UFSAR for Unit 2, a local PMP value of 8.4 in./hr (21.3 cm/hr) using the Hydrometeorological Report (HMR) No. 33 (National Oceanic and Atmospheric Administration (NOAA), 1956). Using this PMP value, the licensee determined a design basis flood elevation of 261 ft (79.6 m) that was in turn used to design walls and foundations of Category 1 Structures (FHRR Section 1.3.2). In estimating the design basis flood level, the licensee conservatively assumed that the storm drains are inoperable, and that the culverts located southwest of the NMP Unit 1 switchyard are not blocked. The maximum flood level for NMP Unit 2 was recalculated considering the following three combined scenarios:

- PMP values estimated using the guides in HMR-51 (NOAA, 1978) and HMR-52 (NOAA, 1982) plus historical maximum lake water level of 250.2 ft (76.3 m). This scenario results in an onsite flood elevation of 262.5 ft (80.0 m) in the vicinity of the plant buildings.
- Historical maximum precipitation and probable maximum lake stillwater level of 254 ft (77.4 m). This gives a flood elevation of 260.4 ft (79.4 m) on the north of the plant buildings.
- Probable maximum wind storm with the effects of wind-wave actions.

Based on the simulation of these three scenarios, the licensee determined that LIP flooding caused by the first scenario is a controlling flooding mechanism that results in the design basis flood level of 262.5 ft (80.0 m).

In summary, NMP Unit 1 was licensed prior to the issuance of the 1975 SRP and a flooding analysis was not documented in the FSAR when NMP Unit 1 was licensed. For NMP Unit 2, the licensee documented that it considered all flooding mechanism cited in the SRP, and selected the maximum PMP-induced LIP water height as the controlling flood mechanism. The licensee reported in the FHRR that the design basis PMP for NMP Unit 2 has a rainfall depth of 9.9 in. (25.1 cm) with duration of 20 minutes. The current design basis flood elevations for various flood causing mechanisms are summarized in Table 3.1-1.

3.1.3 Flood-related Changes to the Licensing Basis

The licensee noted in the FHRR that there have been no flood-related changes or changes to flood protection measures beyond the flood protection measures in place for the current design basis.

3.1.4 Changes to the Watershed and Local Area

The licensee reported in the FHRR that Lake Ontario outflows have been regulated since 1960. Over the past three decades of regulation, the range of long-term lake levels has been reduced from 6.6 ft (2.0 m) to 4.3 ft (1.3 m), with the post-regulation lake levels ranging from 245.7 ft (74.9 m) to 247.4 ft (75.4 m).

The licensee stated in the FHRR that NMP Unit 2 was under construction when NMP Unit 1 began to operate. In a revised plant flood calculation (NMP2, 2012) the licensee evaluated changes to the site consistent with most nuclear plant sites. Additional local area changes to both units' areas include addition of security barriers, relocation of the security fence, relocation and addition of trailers and a truck unloading area constructed with an inflatable berm, and removal of several minor structures. Section 3.2 of this report addresses the effects of these structural changes on estimating LIP floods.

3.1.5 Current Licensing Basis Flood Protection and Pertinent Flood Mitigation Features

The licensee stated in the FHRR that there is no change to the licensing basis flood elevations and flood protection changes, and that the NRC staff's review of the IPEEE identified no vulnerabilities with respect to external flooding. The licensee also stated that all personnel entrances and equipment accesses to Seismic Category I structures for the plants are at or above an elevation of 261 ft (79.6 m); that all penetrations through the exterior walls below the grade level have watertight penetration sleeves; and that underground cables are protected from wetting or flooding by concrete conduits.

3.1.6 Additional Site Details to Assess the Flood Hazard

The licensee provided electronic copies of the input files used for FLO-2D and CulvertMaster modeling in the LIP and river flood analyses in response to RAI 3.2-1 (Korsnick, 2013).

3.1.7 Results of Plant Walkdown Activities

Requested Information Item 1.c and Attachment 1 to Enclosure 2, Step 6, in the 50.54(f) letter requires licensees to report any relevant information from the results of the plant walkdown activities associated with Enclosure 4 of the 50.54(f) letter. Section 3.2 of the FHRR summarizes the following findings from the Recommendation 2.3 walkdown:

- All structure penetrations below elevation 261 ft (79.6 m) are sealed against water.
- The current licensing basis LIP flood level for NMP Units 1 and 2 are 261.75 ft (79.8 m) and 262.5 ft (80.0 m), respectively.
- If water flows into the diesel rooms of NMP Unit 1 due to a LIP event, the flooding could lead to a loss of offsite power and diesel generator failure. However, the licensee stated that the impact of LIP flooding to the SSCs was determined to not present a significant hazard.
- Flexible caulking materials protect the NMP Unit 2, Diesel Generator Building for LIP flood levels up to elevation 263 ft (80.2 m).

3.2 Local Intense Precipitation and Associated Site Drainage

The licensee reported in the FHRR that the reevaluated flood elevations, including plausible associated effects, for LIP are 262.4 ft (80.0 m) in the immediate vicinity of NMP Unit 2. This flood-causing mechanism is not described in the licensee's current design basis for Unit 1. The current design basis flood elevation for the LIP and associated site drainage hazard for NMP Unit 2 is 262.5 ft (80.0 m). For NMP Unit 1, FHRR Section 1.3.1 states that NMP Unit 1 was designed and built prior to issuance of the SRP criteria for external floods. The licensee assessed LIP flooding as part of the IPEEE using calculations from NMP Unit 2 to determine that a PMP event was the only flooding scenario of concern with a maximum water surface elevation for NMP Unit 1 of 261.75 ft (79.8 m).

To provide additional information in support of the summaries and conclusions in the FHRR, the licensee made several calculation packages available to the staff via an electronic reading room. These calculation packages expand upon and clarify the information provided on the docket.

The staff requested additional information from the licensee to supplement the FHRR. The licensee (Korsnick, 2013) provided the additional information which is discussed below.

The staff reviewed the LIP and associated site drainage, including associated effects, against the relevant regulatory criteria based on present-day methodologies and regulatory guidance.

The licensee followed the hierarchical hazard assessment approach of NUREG/CR-7046 (NRC, 2011e). Specifically, the licensee conservatively adopted the assumption that "the design of the site grade and the passive drainage channels are incapable of routing any flow from the immediate plant site, and therefore, overland flow occurs over the whole plant site during the local intense precipitation event" (e.g., Case 3 in Appendix B of NUREG/CR-7046).

Rather than using the precipitation data associated with the licensing of NMP Units 1 or 2, the licensee's LIP reevaluations in the FHRR relied on more recent PMP information generated as part of the LIP flooding analysis for the proposed NMP Unit 3 Combined License Application (COLA) (Unit 3 by UniStar Nuclear Energy, 2009). To be conservative, the licensee assumed zero runoff losses during the LIP event in order to maximize flooding elevation (i.e., no infiltration and no initial abstraction).

FLO-2D, a two-dimensional hydrodynamic computer model, was used to calculate the flooding due to LIP (FLO-2D, 2009). This model is expected to simulate surface runoff in a complex area more accurately than a one-dimensional model.

Section 1.6.3 of the FHRR describes onsite changes after plant operation, including addition of security barriers, relocation of the security fence, and relocation and addition of trailers and the truck unloading area with an inflatable berm. As the FHRR and calculation package did not discuss how these changes were incorporated into the LIP flood analyses, the staff issued a RAI. In response to this RAI (Korsnick, 2013), the licensee provided detailed features of the changes and the assumptions used to model the features in FLO-2D as summarized below:

- Features, such as inflatable berm, security fences, and trailers were not included in FLO-2D, as they have minor or no impacts on the site flood estimations.
- The licensee conservatively omitted concrete security barriers that restrict flood water from flowing onto the site.
- The flood control berms around the powerblock area were modeled as levees in FLO-2D.
- Culverts that convey flow into the site were modeled in FLO-2D, while culverts that convey flow away from the site were considered to be blocked conservatively.

The staff determined that the above assumptions are conservative and acceptable in terms of the current regulatory guidance, and followed the hierarchical hazard assessment approach described in NUREG/CR-7046 (NRC, 2011e). The staff found through a review of the FLO-2D input files that the locations and elevations for control berms and culverts modeled in the FLO-2D are accurate.

The calculated LIP flooding in the FHRR is the result of the PMP centered over the site and its local watershed. Key drainage features include Lakeview Creek to the southwest and two unnamed onsite drainage ditches.

The PMP event described in the FHRR analysis is the same as that for the LIP flooding analysis described in the COLA for proposed reactor NMP Unit 3 (Unit 3 FSAR: UniStar Nuclear Energy, 2009). HMR 51 (NOAA, 1978) and HMR 52 (NOAA, 1982) were applied and three PMP durations were evaluated. Total rainfall depths for the 1 mi^2 (2.59 km^2) area are 16.0 in. (40.6 cm) for the 1-hour PMP, 22.4 in. (56.9 cm) for the 6-hour PMP, and 33.0 in. (83.8 cm) for the 72-hour PMP. Digital elevation data used in FLO-2D were based on a 1999 site topographic map. Manning's roughness coefficient ("n-value") is based on land cover and the FLO-2D guidance (FLO-2D, 2009). Other input to the FLO-2D program included levees (except for portions of the East Berm because they are not connected to the warehouse), a representation of the culvert that conveys flow toward NMP from the Lake Road vicinity, and incorporation of buildings and other features that would impede runoff.

The licensee described in the FHRR 2.1.2.3 that the 72-hour PMP yields flood elevations up to approximately 0.6 ft (0.18 m) higher than the results from the 6-hour PMP simulation. The 72-hour PMP provides a maximum calculated flood elevation of 260.6 to 262.4 ft (79.4 to 80.0 m), with a maximum water depth of 0.3 to 2.8 ft (0.09 to 0.85 m) in the immediate vicinity of

NMP Units 1 and 2. Flood elevations of up to 263.7 ft (80.4 m) were calculated for non-safety related structures east of NMP Unit 2. In the licensee's response to a staff issued RAI (Korsnick, 2013), the licensee provided the following flood event duration parameters associated with the 72-hour PMP event: (1) flood warning time of 25 hours; (2) flood inundation duration of approximately 20 hours above elevation 261 ft (79.55 m); and (3) flood recession duration of 32.5 hours for the 72-hour PMP. These flood event duration parameters were identified using an overlay of Figures 2.1-3 and 2.1-23 of the FHRR, which was contained in the RAI response. A similar comparison using FHRR Figures 2.1-3 and 2.1-15 for the 6-hour PMP results in: (1) flood warning time of less than one hour (see FHRR Figure 2.1-15) and (2) a flood inundation duration of 14.5 hours above elevation 261 ft (79.55 m). Therefore, the NRC staff agreed with the licensee's conclusion that the 72-hour PMP event results in the highest water surface elevation and longest period of inundation. However, the staff noted that PMP events shorter than 72-hour PMP (e.g., the 6-hour PMP event identified above) result in potentially significantly shorter warning time and likewise results in a flood above the elevation of openings to plant structures (261 ft; 79.55 m).

The NRC staff found from the review of the FHRR and the RAI responses that the licensee had not discussed the effects of building roof drain features on the LIP flood estimation, and thus issued an RAI. In the response to this RAI (Korsnick, 2013), the licensee stated that rainfall on buildings is a minor contributor to runoff volume because building surface area represents less than two percent of the contributing watershed area to the site. The licensee further stated that the impact of building runoff on peak flood surface elevation is not significant because building runoff would occur rapidly compared to the watershed runoff. The staff reviewed the input and output files of the FLO-2D model provided by the licensee. The staff found that runoff from rooftops is assumed to be removed completely from the model domain rather than discharging to the ground surface near the structure or an adjacent area, resulting in a potential underestimation of the maximum LIP flood levels. The NRC staff noted that this modeling deficiency was not addressed in the FHRR or the response to this RAI (Korsnick, 2013). However, since the LIP mechanism is being evaluated as part of an Integrated Assessment, the staff determined that this numerical modeling issue can be appropriately resolved as part of the Integrated Assessment. This is Integrated Assessment Action Item No. 1.

To summarize, the licensee determined that the maximum LIP flood elevation is caused by a 72-hour PMP and provided a discussion in NMP FHRR Section 2.1.3. Flood elevations would be as much as 262.2 ft (80.0 m) at NMP Unit 1, which is higher than the current licensing basis LIP flood level of 261.75 ft (79.8 m) as reported in the IPEEE submittal. At NMP Unit 2, the maximum flood elevation would be 262.4 ft (80.0 m), which is below the current design basis LIP flood elevation of 262.5 ft (80.0 m).

The staff noted that the FHRR analysis has the following three important differences compared to the current design basis flood analysis:

- The current design basis LIP flood analysis assumed onsite drainage culverts to be 100 percent open, while the FHRR assumed them to be 100 percent blocked or fully open if they are used to discharge water from the surrounding areas into the site.

- The current licensing basis assumed a 20-minute, 9.9-inch (25.2 cm) PMP in contrast to the FHRR analysis of up to 72-hour PMP events.

- Also, in the FHRR, runoff losses were conservatively assumed to be zero.

According to the Unit 2 UFSAR (UniStar Nuclear Energy, 2011), building entrance elevations to all Category I Structures are 261 ft (79.6 m). For Unit 1, the maximum flood elevation of 262.2 ft (79.9 m) exceeds the Category 1 Structures entrance elevations for approximately 19 hours during the 72-hour PMP. For NMP Unit 2, the maximum flood elevation of 262.4 ft (80.0 m) exceeds the Category 1 Structures entrance elevations for approximately 20 hours during the 72-hour PMP.

For NMP Unit 2, the flood duration above elevation 261 ft (79.6 m) increased, which impacts the amount of water ingress into structures. For NMP Unit 1, the flood duration as well as the flood elevation height increased relative to previous calculations. For these reasons, the licensee concluded that the reevaluated flooding hazard due to LIP is not bounded by the current design basis for the site.

The licensee's LIP analysis focuses on water above the land surface, with the assumption of no infiltration and blockage of onsite drainage systems by debris or sedimentation. The NRC staff noted that this assumption provides a conservatively high estimate of standing water. The NRC Staff considered adverse effects of hydrodynamic forces generated by LIP flood, such as wind effects, groundwater ingress, and other adverse weather conditions, and determined that these effects were conservatively accounted for in the licensee's calculations.

The information on flooding from LIP and associated site drainage that is specific to the data needs of the Integrated Assessment is described in Section 4 of this staff assessment.

The staff confirmed the licensee's conclusion that the reevaluated flood hazard for LIP and associated site drainage is not bounded by the current design basis flood hazard; therefore, the licensee should include LIP and associated site drainage within the scope of the Integrated Assessment. However, the NRC staff determined that the licensee should resolve the issue related to the roof drainage modeling, and the associated removal of this flow from the model domain rather than discharging to the ground surface near the structure or an adjacent area, as part of the Integrated Assessment Action Item No. 1.

3.3 Streams and Rivers

The licensee reported in the FHRR that the reevaluated hazard, including associated effects, for site flooding from stream and rivers does not inundate the plant site. This flood-causing mechanism is not described in the licensee's current design basis.

To provide additional information in support of the summaries and conclusions in the FHRR, the licensee made several calculation packages available to the staff via an electronic reading room. These calculation packages expand upon and clarify the information provided on the docket.

The NRC staff requested additional information from the licensee to supplement the FHRR. The licensee provided this additional information dated December 19, 2013 (Korsnick, 2013).

The staff reviewed the licensee's evaluation of site flooding from streams and rivers, including associated effects, against the relevant regulatory criteria based on present-day methodologies and regulatory guidance below.

The licensee reported in the FHRR that Lakeview Creek is the nearest perennial stream to NMP; however this creek lies outside of the NMP site. The Lakeview Creek has a drainage area of 4.9 mi^2 (12.7 km^2). There are no existing stream gages, dams, reservoirs, or other types of water control structures within the Lakeview Creek basin. The discharge point of Lakeview Creek to Lake Ontario is located approximately 1 mi (1.6 km) west from the plant site. The licensee analyzed the PMP on the Lakeview Creek basin using the guidance in HMR 51 (NOAA, 1978) and HMR 52 (NOAA, 1982). The estimated 72-hr PMP is 33 in. (83.8 cm). The licensee used Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS: US Army Corps of Engineers (USACE), 2000) to calculate watershed runoff from a PMP scenario. The licensee used the following three assumptions in the modeling:

- Selected a conservative Soil Conservation Service (SCS) Curve Number of 89 under a wet land surface condition before the PMP event.

- Applied 40 percent of the 72-hr PMP value as an antecedent storm.

- Adjusted the SCS-oriented unit hydrograph by increasing 20 percent of the peak discharge and decreasing 33 percent of time-to-peak as recommended by NUREG/ CR-7046 (NRC, 2011e). The adjusted lag time and time-to-concentration for the Lakeview Creek basin are 2.8 hours and 4.6 hours, respectively.

The licensee considered seasonal variability of PMP using HMR 53 (NOAA, 1980) and snowmelt contribution using the energy budget method. The licensee used HEC-HMS (USACE, 2000) to estimate probable maximum flood (PMF) runoff. The calculated unit hydrograph using the SCS method was used in HEC-HMS in place of lag time to compute the PMF on Lakeview Creek. The licensee obtained the PMF runoff rate of 17,290 cubic feet per second; (cfs; 849.6 cubic meters per second (cms)).

The licensee used FLO-2D to estimate the flood levels caused by the river PMF. The major features of the licensee's FLO-2D model are summarized as following:

- The upstream inflow to the FLO-2D model was the PMF hydrograph obtained from an HEC-HMS model

- Selected conservative Manning's n-values: 0.005 for highly developed area, 0.4 for forest, and 0.04 for creeks.

- Flood control berms around the plant site were represented in FLO-2D via the levee option.

- Modeled inflows through the Lake Road Culvert to the site, but conservatively ignored the on-site channels and other culverts within the onsite berms.

- Use of areal and width reduction factors to represent the interruption of flow by buildings and other plant facilities.

- Grid elements along the lakeshore were defined as outflow nodes.

Using the FLO-2D model, the licensee obtained a maximum flood level of 277 ft (84.4 m) at the creek outlet in the vicinity of the plant site. The divide elevation between the Lakeview Creek and the plant site is approximately 288 ft (87.8 m). Therefore, the licensee concluded that the PMF does not affect the plant site.

The staff reviewed the licensee's modeling and determined that the licensee followed present-day regulatory guidance in NUREG/CR-7046 (NRC, 2011e) and RG 1.59 (NRC, 1977) by postulating a PMP scenario (e.g., depth and duration), setting an antecedent PMP condition, adjusting for the nonlinearity of unit hydrograph, and incorporating topographic features within the basin. The staff confirmed using the HMR 51 (NOAA, 1978) that the licensee's 72-hr PMP value of 33 in. (83.82 cm) for the Lakeview Creek is accurate.

The staff also reviewed the licensee's HEC-HMS model. The Curve Number value in the SCS runoff transformation is generally determined based on the condition of hydrologic soil groups and land use types. The staff identified from the FHRR that the Lakeview Creek basin is mostly (>70 percent) covered by forest, and that most of the basin area (>95 percent) is the SCS Type D soil which has the highest runoff potential. The licensee conservatively selected a lag time in HEC-HMS as 60 percent of the time-of-concentrations for both sheet and channel flows following the guidance in the HEC-HMS User Manual (USACE, 2000).

As the staff reviewed the licensee's calculation packages for river and stream flooding analyses, the staff requested the licensee provide the electronic versions of the FLO-2D input files. The licensee used a Manning's n-value of 0.04 for the creek bottom which is covered mostly by vegetation and rocks as mentioned in the FHRR. The staff notes this n-value is conservatively low as the actual creek bottom is an unimproved small creek that would have a higher n-value. Based on a review of the FHRR, calculation packages, topographic maps, and FLO-2D input files, the staff found that the licensee's FLO-2D modeling approach follows the present-day methods and guidance.

In addition to reviewing the licensee's modeling, the staff performed an alternative approach to validate the licensee's river PMF hazard analysis as summarized below:

1) The staff estimated PMF rates using four simple bounding empirical PMF equations as summarized in Table 3.3-1, then selected the highest PMF rate of 24,430 cfs (692 cms) which is about 140 percent larger than the licensee's PMF estimate.

2) Using a flood plain width of about 2,500 ft (762 m) at the Lakeview Creek basin outlet, the staff calculated a flow depth of 4 ft (1.2 m) for the licensee estimated PMF rate of 17,290 cfs (490 cms). The staff obtained a corresponding PMF velocity of 2.2 ft/sec (0.67 m/sec) using the Manning's equation.

3) Using the Manning's equation with the above velocity and the staff's PMF rate, the staff obtained a PMF flow depth of 5.6 ft (1.7 m) and a corresponding PMF elevation of 279 ft (85 m).

This bounding PMF water elevation at the Lakeview Creek is much lower than the divide elevation between the creek and the site (i.e., 288 ft (87.8 m)). Correspondingly, the staff confirmed that the PMF from Lakeview Creek alone could not induce flooding of the plant site.

In summary, the staff confirmed the licensee's conclusion that the PMF from Lakeview Creek alone could not inundate the plant site. Therefore, the staff confirmed that the reevaluated hazard for flooding from streams and rivers is bounded by the current design basis flood hazard.

3.4 Failure of Dams and Onsite Water Control/Storage Structures

The licensee reported in the FHRR that the reevaluated PMF elevation, including associated effects, for site flooding due to failure of dams and onsite water control/storage structures does not inundate the plant site. This flood-causing mechanism is not described in the licensee's current design basis.

To provide additional information in support of the summaries and conclusions in the FHRR, the licensee made several calculation packages available to the staff via an electronic reading room. These calculation packages expand upon and clarify the information provided on the docket.

The staff describes its evaluation of site flooding from failure of dams and onsite water control/storage structures, including associated effects, against the relevant regulatory criteria based on present-day methodologies and regulatory guidance below.

The licensee adopted in the FHRR the dam breach flood analysis performed for the NMP Unit 3 COLA (Unit 3 FSAR, UniStar Nuclear Energy, 2009). Use of the NMP Unit 3 dam failure analysis to the FHRR is relevant because the three units are co-located.

In the FSAR for NMP Unit 3 the licensee analyzed a potential dam failure flooding in the Oswego River basin. The Oswego River is located approximately 6.5 mi (10.5 km) west of the site and has a drainage area of approximately 5,100 mi^2 (13,203 km^2). The Oswego River is used for navigational purposes and carries the Oswego Canal along its entire length. The Oswego River basin, as well as the plant site basin and the Lakeview Creek basin, discharge directly and independently into the Lake Ontario. The licensee identified six dams/locks on the Oswego River. The licensee assumed that the six dams/locks on the Oswego River fail simultaneously (not serially) and discharge water into the lake without loss or attenuation. The area of the lake is approximately 4.7 million acres (19,000 km^2), thus a corresponding water level increase in the Lake Ontario would be approximately 0.2 in. (0.5 cm), which is insignificant. The licensee stated in the FHRR that there are no on-site basins that could contribute to flooding of SSCs important to safety via a dam/dike break.

The staff performed a bounding analysis of dam failure flooding in the Oswego River basin. From the 2013 National Inventory of Dams Database maintained by USACE, the staff identified a total of 123 dams within the Oswego River basin (see Figure 3.4-1). Most of the identified dams (about 110 dams) have storage capacity less than 10,000 ac-ft (0.012 km^3). The total reservoir volume of these 123 dams is approximately 2,008,600 ac-ft (2.47 km^3). The staff conservatively assumed all dams fail simultaneously and discharge water into Lake Ontario without loss. With the surface area of Lake Ontario of 4.7 million acres (19,000 km^2), this bounding approach results in a lake level increase of approximately 0.43 ft (0.13 m) which is higher than the licensee's estimate but well below the plant grade and the current design basis flood height.

The entrance to the Saint Lawrence River, which drains water from Lake Ontario, is located approximately 50 miles (80 km) north of the site. This river is used in conjunction with three dams to control the level of Lake Ontario. The licensee stated that failure of these dams will not create flooding at the plant site but would result in lake level drawdown. The staff agreed with the licensee's conclusion that the impact of any Saint Lawrence River dam failure scenario could not flood the site.

The staff identified that Lake Ontario receives water from Lake Erie at an average rate of about 206,000 cfs (5,800 cms) which is about 80 percent of the total inflow of Lake Ontario (USGS, 2005). However, there are no dams on the connecting channels between the two lakes. The staff identified that Lakeview Creek which travels along the southwest corner of the site has a drainage area of approximately 5 mi^2 (12.9 km^2), but there are no dams within the basin. The staff also found no on-site basins that could contribute to flooding of SSCs important to safety via a dam/dike break.

In summary, the staff confirmed the licensee's conclusion that the PMF from dam failure flooding alone could not inundate the site. The staff confirmed that the reevaluated hazard for flooding from the failure of dams and onsite water control/storage structures is bounded by the current design basis flood hazard.

3.5 Storm Surge

The licensee reported in the FHRR that the reevaluated PMF elevation, including associated effects, for site flooding due to storm surge is 258.1 ft (78.6 m) for both NMP Units 1 and 2. This flood-causing mechanism is described in the licensee's current design basis for NMP Unit 2. The current design basis hazard for site flooding due to storm surge is 261 ft (79.6 m) for NMP Unit 2. This flood-causing mechanism is not described in the licensee's current design basis for NMP Unit 1.

To provide additional information in support of the summaries and conclusions in the FHRR, the licensee made several calculation packages available to the staff via an electronic reading room. These calculation packages expand upon and clarify the information provided on the docket.

The licensee stated that it used the hierarchical hazard assessment (HHA) approach described in NUREG/CR-7046 (NRC, 2011e) to calculate the Probable Maximum Storm Surge (PMSS) at NMP Units 1 and 2. The licensee's methodology includes the following steps as defined in ANSI/ANS 2.8-1992 (ANSI/ANS, 1992):

- Selection of the historic design storm by performance of a statistical analysis of NOAA one hour water level and six minute water level data to: (a) eliminate long term water level fluctuations; (b) identify the short term water level fluctuations; and (c) identify the historical storm and storm type resulting in the highest recorded wind speeds and storm surges.

- Development of the probable maximum wind speed (PMWS) meteorological parameters by modification of the historical storm parameters in accordance with ANSI/ANS-2.8-1992 (ANSI/ANS, 1992).

- Development of the antecedent water level by comparing the maximum controlled water level elevation on Lake Ontario to the 100-year high water level, and selecting the lesser water elevation.

- Calculation of the PMSS still water elevation using the NOAA Great Lakes Storm Surge Planning Program (SSPP).

The licensee stated that its selection of the design storm is consistent with NUREG/CR-7046 and ANSI/ANS-2.8-1992. The licensee reviewed and analyzed the NOAA National Climatic Data Center (NCDC) water level data from nearby NOAA Tides and Currents stations and the NOAA National Hurricane Center (HURDAT) data to identify the historic storm for development of the PMWS parameters. The licensee selected a February 17, 2006 storm due to its combination of the second highest surge and the highest recorded wind speed, as the model storm and modified, per ANSI/ANS-2.8-1992, to develop the PMWS parameters. For wind field development, the licensee used the three hour pressure maps for the selected storm obtained from the NCDC (NOAA, 2006). The pressure maps were geo-referenced to calculate the isobars, distance between isobars, and wind angles affecting the lake and to establish a relationship between the pressure maps and a geographic coordinate system in order to determine storm speed.

The licensee divided Lake Ontario into three zones to develop a spatially varying wind field. The licensee used the isobar patterns along the storm path to calculate the PMWS time varying pressure, wind speed and wind direction at the eastern and western ends of each zone using the methods presented in the USACE Coastal Engineering Manual (CEM) (Resio et al., 2008). In order for the maximum wind speed to reach 100 mph (44.7 m/s) (ANSI/ANS, 1992) in each zone, the wind speeds were scaled up by a factor equal to a ratio times the maximum over-water wind speed 100 mph (44.7 m/s). In order for the minimum pressure to reach 950 millibars (mbar) (ANSI/ANS, 1992), the minimum pressure of the storm, 992 mbar, was scaled down to 950 mbar. The licensee stated that the PMWS track is consistent with the tracks of the other representative storms that generated significant surges at the site which have three hour surface pressure maps available.

The licensee performed a frequency analysis of the monthly mean water level data from NOAA Station 9052030 (Oswego, NY), for the period of time corresponding to the period that the Lake Ontario water level has been regulated and controlled (1963 to 2012). The licensee used a Log-Pearson III statistical analysis and U.S. Department of Interior guidelines (U.S. Dept. Interior, 1982) to calculate a 100-year high water level of 249.1 ft (75.9 m).

As defined in Appendix H of NUREG/CR-7046 (NRC, 2011e), the licensee stated that for enclosed bodies of water, the lesser of the 100-year level or the maximum controlled water level should be used for the evaluation of flood levels from storm surges during development of the antecedent water level. Since the maximum controlled water level elevation level of 248.0 ft (75.6 m) is less than the 100-year water level elevation of 249.1 ft (75.9 m), the licensee selected 248.0 ft (75.6 m) as the ambient water level for the PMSS calculation.

The licensee used the SSPP to predict the surge elevation due to the PMWS (Schwab et al., 1987). The licensee ran the SSPP model for a sustained wind speed of 100 mph (44.7 m/s) and also varied the wind direction in 10 degree increments between 250 and 300 degrees to determine the wind direction which results in the greatest surge elevation at NMP. The resulting

SSPP predicts a maximum still water level increase of 4.8 ft (1.5 m) at NMP which corresponds to a PMSS still water level of 252.8 ft (77.1 m).

The licensee performed a comparative analysis of measured water levels to those predicted using the SSPP as part of the NMP flood re-evaluation and model validation in accordance with Section 5.5 of NUREG/CR-7046 (NRC, 2011e). The licensee calculated storm surges from nine representative, historic storms using the SSPP and the results were compared to the measured surge elevations. The licensee extracted the filtered six-minute water level data at three of the four NOAA Tides and Currents stations along the south shore of Lake Ontario (Olcott, Rochester, and Oswego, NY) and compared them with outputs from the SSPP.

The licensee extracted wind data for the above storms from six NOAA NCDC stations around Lake Ontario noting that the distribution of these stations around the lake provides representative winds around the entire lake. The licensee converted each station's maximum wind speed, and associated wind direction to hourly overwater wind speeds in miles per hour to determine a spatially averaged wind speed over the entire lake. The licensee stated that, using the spatially averaged constant wind field over the entire lake as input, the SSPP results reasonably and conservatively predicted the surge elevation at Oswego, near NMP Units 1 and 2, when compared to measured water levels during the storm. The licensee calculated a correlation coefficient between the SSPP predicted values and the NOAA measured storm surge values of 0.95. A linear collated trend line indicates some model bias to under predict surge elevation at low surge values and over predict surge elevation at moderate to high surge values.

The licensee calculated the wave runup heights using the USACE Coastal Engineering Design and Analysis System (CEDAS) for NMP Unit 2 based on the runup due to the maximum depth limited wave height at the revetment toe. The licensee wave runup heights ranged up to 4.8 ft (1.5 m). According to the licensee, the topography south of the Unit 1 dike forms a swale or ditch, which appears to generally flow from east to west. The bottom of the swale ranges in elevation from approximately 250 to 252.6 ft (76.2 m to 76.9 m), well below the site grade elevation of 261 ft (79.6 m). For both NMP Units 1 and 2, the maximum calculated water surface elevation due to wave overtopping is 258.1 ft (78.6 m) at the plant side of the swale/ditch. This elevation is 3 ft (0.9 m) below the entryways to safety-related SSCs and at least 2 ft (0.6 m) below typical plant grade.

The staff describes its evaluation of site flooding from storm surge, including associated effects, against the relevant regulatory criteria based on present-day methodologies and regulatory guidance below.

The staff reviewed the NOAA databases cited by the licensee, including the climatology of Lake Ontario, and confirmed that the controlling storm for PMSS calculations is an extra-tropical storm. The staff concludes that the licensee applied the appropriate storm parameters per ANSI/ANS-2.8-1992. The storm parameters are the basis for the SSPP model used to calculate the PMSS. The NRC staff notes that the licensee introduced assumptions regarding the storm properties and model inputs into the results by:

- Smoothing and reducing the translation speed of the PMWS storm track storm to 40 mph (17.9 m/s) (which was the minimum recorded storm speed) to increase the effect of the pressure gradients and resulting wind speeds.

- Increasing the predicted peak wind speed for the PMWS to reflect a maximum over-water wind speed of 100 mph (44.7 m/s) as recommended in Section 7.2.2.3.1, "Basic Input," of ANSI/ANS-2.8-1992.
- Assuming that the synthetic storm wind speeds and direction are temporally and spatially constant to maximize the storm surge.
- Performing a sensitivity analysis on the peak wind speed direction by analyzing the surge elevations relative to varying wind directions, to determine the wind direction resulting in the maximum surge elevation at the NMP site. The selected track direction of 280 degrees is aligned with the west-east orientation of Lake Ontario, maximizing the effective fetch.
- Performing a validation of the surge model by comparing predicted water levels to measured water levels for a number of historic lake storm surges; the validation indicates that the model over predicts surge elevations at moderate to high surge values.
- Applying the state-of-the-art CEDAS model for wave runup calculations resulting in an increase in wave runup of 0.45 to 1.16 ft (0.20 to 0.52 m) for a wave runup range of 7.45 to 8.16 ft (3.33 to 3.65 m) compared to the NMP Unit 2 CLB of 7 ft (3.13 m). Although the wave runup is greater than the current NMP Unit 2 CLB, the stillwater elevation is calculated to be lower.

In summary, the staff confirmed the licensee's conclusion that the PMF from reevaluated hazard for flooding from storm surge is bounded by the current design basis flood hazard for NMP Unit 2. The staff also confirmed the licensee's conclusion that the PMF from storm surge alone could not inundate NMP Unit 1.

3.6 Seiche

The licensee reported in the FHRR that the reevaluated PMF elevation, including associated effects, for site flooding due to seiche effects is not expected to be greater than the predicted PMSS still-water level of elevation 252.8 ft (77.1 m). This flood-causing mechanism is described in the licensee's current design basis.

To provide additional information in support of the summaries and conclusions in the FHRR, the licensee made several calculation packages available to the staff via an electronic reading room. These calculation packages expand upon and clarify the information provided on the docket.

Due to the coastal setting of NMP on the shore of Lake Ontario, the licensee used the HHA approach described in NUREG/CR-7046 (NRC, 2011e) to determine whether a seiche in Lake Ontario can result in significant flooding at NMP Units 1 and 2.

The licensee's seiche evaluation methodology included: (1) the determination of the natural period of Lake Ontario at Oswego (nearest NOAA water level station); (2) identification of the periods of meteorological external forcing events (e.g., extra-tropical storms) and comparison of the external forcing and lake periods to determine if resonance is expected; and (3) evaluation of potential seiche heights.

The licensee stated that the occurrence of lake seiches is a result of the oscillating response to a storm surge. On Lake Ontario, recorded seiches with the largest amplitudes are associated with long period, non-convective extra-tropical storms with winds blowing parallel to the long access of the lake causing a set-up at the downwind end of the lake and a corresponding water level set-down at the upwind end of the lake. Based on the licensee's analysis, the fundamental oscillation period of Lake Ontario at Oswego is approximately 5 hours.

Licensee observations of the water level data indicate that the initial storm surges are followed by a series of oscillations (standing waves) which can be both forced (during periods of high winds) and free (once the storm has passed and the winds have subsided). The observed period of oscillations with significant amplitude is consistent with the fundamental period of the lake and the amplitudes decrease with time due to friction. Therefore, resonance between the principal forcing wind events and the lake is not expected.

The licensee stated that seiches could also occur in the vicinity of NMP due to storms (e.g., a northerly tracking tropical storm) that do not cause an initial storm surge at NMP. Because spectral analysis of water level data and numerical modeling indicate that seiche amplitudes are similar on both ends of the lake, the licensee stated that seiches are not expected to be the controlling flood event at NMP. Licensee comparisons of surge and seiche heights for nine representative storms with high recorded surges on Lake Ontario show oscillation amplitudes less than the storm surge amplitude of 1.5 ft (0.45 m).

The NRC staff reviewed the licensee's evaluation of site flooding from seiche, including associated effects, using relevant regulatory criteria based on present-day NRC methodologies and regulatory guidance as discussed below. The staff noted that the licensee's seiche hazard evaluation for Lake Ontario is also consistent with guidance developed by other federal agencies for the Great Lakes (e.g., FEMA, 2012).

The three lowest periods (5.11, 3.11, 2.13 hours) determined by the licensee's spectral analysis is consistent with previous studies for Lake Ontario (Rabinvich, 2009; Hamblin 1982; Li et al., 1975 and Simpson et al., 1964). Using Merian's formula (Scheffner, 2008) to approximate the natural seiche period for Lake Ontario, the staff calculated results consistent with these observed periods (Rueda and Schladow, 2002; Hamblin, 1982). Thus, the staff concludes that the licensee's analysis and use of water level data for extracting the seiche period for Lake Ontario is appropriate given the availability of observed data near NMP (i.e., NOAA Oswego water level station).

In the context of the above discussion, the staff concurs with the licensee's analysis results. The peaks associated with wind forcing at the fundamental modal seiche periods (5.11, 3.11, 2.13 hours) are not present in the frequency analysis of the wind speed data, thus precluding resonance of Lake Ontario.

In summary, the staff confirmed the licensee's conclusion that the PMF from seiche alone could not inundate the site. The staff confirmed that the reevaluated hazard for flooding from seiche is bounded by the current design basis flood hazard.

3.7 Tsunami

The licensee reported in the FHRR that the reevaluated PMF elevation, including associated effects, for site flooding due to tsunami is 259.93 ft (79.22 m). This flood-causing mechanism is not described in the licensee's current design basis.

The licensee used the HHA approach described in NUREG/CR-6966 (NRC, 2009) for the tsunamis hazard assessment which included: (1) performing a regional survey to determine if the site region is subject to tsunamis; (2) assessing the mechanisms likely to cause a tsunami; and (3) performing a site screening to determine the potential tsunami effects to the NMP Units 1 and 2.

The licensee's regional survey was in four parts (AREVA, 2013e). First, to review the Global Historical Tsunami Database (NOAA, 2012) to determine the history of tsunamis. The second, third, and fourth parts of the regional survey assessed the mechanisms likely to cause a tsunami. The licensee used the results of the regional survey to identify the primary effects of a tsunami wave near the NMP site and performed a site screening to determine the potential effects (AREVA, 2013e).

As an inland site, the licensee stated that the NMP site is not subject to oceanic tsunamis; however, the licensee conducted a regional survey to consider tsunami-like waves in the area around the Great Lakes. Based on the regional survey, the licensee found seven events that occurred in or near the Great Lakes, all resulting in a seiche and/or disturbance on an inland river, the largest of which was 9 ft (2.7 m) on Lake Erie in 1823.

The licensee stated that earthquake generated tsunamis are limited in Lake Ontario because the required level of seismic activity for development of a tsunami is absent from the region (NRC, 2009, Section 1.3.1). The licensee stated that a tsunami generated by a submarine landslide is unlikely in Lake Ontario due to the limited bathymetric relief of ridges and their respective slopes. The licensee also stated that a tsunami generated by a subaerial landslide is unlikely to occur in Lake Ontario due to limited topographic relief. One area with sufficient topographic relief, Scarborough Bluffs near Toronto, is oriented such that the direction of a landslide and resultant tsunami-like wave would be directed more than 150 mi (241 km) west of the NMP site.

Based on the assessment of the mechanisms likely to cause a tsunami on Lake Ontario, the licensee concludes that the NMP site is not susceptible to tsunamis:

- Lake Ontario is not susceptible to oceanic tsunamis; instead, there is the potential of waves generated by meteorological conditions such as storm surge and seiche.

- The historical database shows no observations of tsunamis generated by earthquakes or landslides.

- The Lake Ontario region is nearly aseismic. The largest recorded earthquakes were magnitude 5.7, while the required level of seismic activity to generate an observable tsunami would have a magnitude greater than magnitude 6.5.

- Submarine landslides, if they occurred, are unlikely to generate an observable tsunami-like wave due to the limited bathymetric relief of ridges (less than 131 ft (40 m)) and their respective slopes in Lake Ontario (less than 10 degrees).

- Subaerial landslides are unlikely to occur around the perimeter of Lake Ontario due to limited topographic relief. The one area with sufficient topographic relief, Scarborough Bluffs near Toronto, is oriented such that the direction of a landslide and resultant tsunami-like wave, if it occurred, would be toward the Niagara River on the southeastern lake shoreline more than 150 miles (241 km) west of the NMP.

The licensee performed the tsunami hazard analysis by using the maximum recorded tsunami-like wave resulting from an earthquake in the Great Lakes region of 9 ft (2.7 m) in 1823 on Lake Erie. The licensee then assumed this tsunami occurring coincident with the maximum (runup) and minimum (drawdown) lake levels of 250.73 ft (76.42 m) to yield a probable maximum tsunami (PMT) height of 259.93 ft (79.22 m). This reevaluated tsunami flood elevation is 1.8 ft (0.54 m) below the grade level of the NMP Unit 1 entrance to SSCs important to safety.

The NRC staff describes its evaluation of site flooding from tsunami, including associated effects, against the relevant regulatory criteria based on present-day methodologies and regulatory guidance below.

The NRC staff reviewed the methodologies used by the licensee to determine the severity of the tsunami phenomena reflected in this analysis and noted that they are consistent with present-day methodologies and guidance. In the context of the above discussion, the staff finds the licensee's analysis and use of these methodologies acceptable. The staff independently reviewed the historical tsunami database and bathymetry data provided by NOAA and agrees with the licensee's findings that tsunami hazards on Lake Ontario are unlikely. In addition, the 1823 historical increase in water level in Lake Erie by 9 ft (2.7 m) was categorized by NOAA as a "seiche" in an inland river and is not considered a tsunami event. Therefore, the 259.93 ft (79.22 m) elevation calculated by the licensee is 1.07 ft (0.33 m) below the NMP Unit 1 grade level.

The NRC staff conducted an independent tsunami study of the NMP site, focusing on submarine landslides, and coastal bluff failure. Relevant data was extracted from the NOAA National Geophysical Data Center (NGDC) online portal from the "Great Lakes Bathymetry Grids." The deepest sections of the lake exceed 787 ft (240 m) in depth, and situated just offshore of the NMP site. From this data, it can be seen that the NMP site sits on ground that is 33 to 66 ft (10 to 20 m) above the lake level, fronted by a shallow 1,640 ft (500 m) long shelf, after which the water depth quickly increases to approximately 656 ft (200 m) within 1,640 ft (500 m) distance. This shallow shelf acts to significantly spread and disperse the wave energy, greatly reducing the amplitude of the waves as they approach the NMP site. Consistent with the licensee's analysis, the staff considered that submarine landslides are a possible source mechanism along the steep slopes of the Rochester Basin. Similarly, the staff noted that the orientation of this source might not be the worst case for the NMP site, as the wave energy will not be directed perfectly at the site, but to a shoreline location a few tens of kilometers to the west. Therefore, the staff concludes that the tsunami effects would not result in a flood in excess of the current design basis at the site.

In summary, the NRC staff confirmed the licensee's conclusion that the PMF from tsunami alone could not inundate the site. The staff confirmed that the reevaluated hazard for flooding from tsunami is bounded by the current design basis flood hazard.

3.8 Ice-Induced Flooding

The licensee reported in the FHRR that the reevaluated PMF, including associated effects, due to ice-induced event does not inundate the plant site. This flood-causing mechanism is not described in the licensee's current design basis.

In particular, the licensee noted that the Saint Lawrence River has been controlled so that the river flow is reduced to form a smooth, stable ice cover that reduces the risk of forming ice jams on the river. Therefore, the licensee concluded that ice-induced flooding at the NMP site caused by ice jams in the Saint Lawrence River is unlikely and would not affect the safety of the NMP plants. The staff found from the ice jam database by USACE (2013) that there are no records of ice jam formation on the Saint Lawrence River causing flooding on Lake Ontario. The International Saint Lawrence River Board of Control regulates Lake Ontario outflow to the Saint Lawrence River and thereby controls lake levels in Lake Ontario.

The staff investigated the potential flooding from ice jams on the Oswego River and Saint Lawrence River. The historical ice jams on record occurred on the Oswego River in January of 1952 and January of 2004. However, the mouth of the Oswego River is located approximately 6.5 mi (10.5 km) west from the plant site. Air temperature measurements at the Oswego East meteorological station indicate that mean daily temperatures at the site can fall below freezing for several months during the winter (NOAA, 2002). Based on the ice jam database by USACE (2013), the staff noted that up to 2.5 ft (0.76 m) of surface ice formation is possible in open water near the plant site introducing the possibility of ice blockage of small catch basins, storm drains, culverts, and roof drains. The licensee stated in the FHRR Section 3.2 that the flood protection design of the plant safety-related facilities assumed that the onsite drainage system, including catch basins, storm drains, and culverts are blocked by ice, snow or other obstructions, rendering them inoperative during a local intense precipitation event. Therefore, the NRC staff concluded that ice jam formation or breaching of ice jam on the Oswego River and Saint Lawrence River would not have adverse flooding impacts to the plant site.

In summary, the staff confirmed the licensee's conclusion that the PMF from ice-induced flooding alone could not inundate the site. The staff confirmed that the reevaluated hazard for ice-induced flooding of the site is bounded by the current design basis flood hazard.

3.9 Channel Migrations or Diversions

The licensee reported in the FHRR that the reevaluated probable maximum flood (PMF), including associated effects, due to channel migrations or diversions does not inundate the plant site. This flood-causing mechanism is not described in the licensee's current design basis.

The Lakeview Creek, the nearest stream to the site, is outside the boundary of the NMP site. The staff reviewed topographic and geological data of this creek area available in the public domain, as well as the FHRR and FSAR, to investigate the potential of Lakeview Creek division. The staff identified that the Lakeview Creek has a wide flood plain, greater than 2,500 ft (762 m), and its basin near the vicinity of the plant is separated from the site by a natural divide.

The divide has a height of approximately 10 ft (3.05 m) from the bottom of the creek with very mild slopes on both sides. Therefore it is not possible for creek water to be diverted to the plant site.

In summary, the staff confirmed the licensee's conclusion that the PMF from channel migrations or diversions could not inundate the site. The staff confirmed that the reevaluated hazard for flooding from channel migrations or diversions is bounded by the current design basis flood hazard.

4.0 INTEGRATED ASSESSMENT AND ASSOCIATED HAZARD DATA

The staff confirmed that the reevaluated hazard result for LIP flooding is not bounded by the current design basis flood hazard. Therefore, the staff concludes that an Integrated Assessment is necessary and must consider the flood-causing mechanism of LIP.

Section 5 of JLD-ISG-2012-05 (NRC, 2012c) describes the flood hazard parameters needed to complete the Integrated Assessment. The staff reviewed the following subset of these flood hazard parameters to conclude that the flood hazard information is appropriate input to the Integrated Assessment:

- Flood event duration (see Table 4.0-1), including warning time and intermediate water surface elevations that trigger actions by plant personnel, as defined in JLD-ISG-2012-05

- Flood height and associated effects, as defined in JLD-ISG-2012-05 (see Table 4.0-2)

The staff requested, via an RAI, the licensee to provide the applicable flood event duration parameters associated with mechanisms that trigger an Integrated Assessment. The relevant flood duration parameters include the warning time the site will have to prepare for the event, the period of time the site is inundated, and the period of time necessary for water to recede off the site for the mechanisms that are not bounded by the current design basis. The licensee's response (Korsnick, 2013) to this RAI is summarized below:

- The LIP-induced flood caused by a 72-hour PMP event results in the highest water surface elevation at the site. Per this flooding mechanism, the maximum flood elevations are 262.2 ft (79.92 m) and 262.4 ft (79.98 m) for NMP Units 1 and 2, respectively, with the following flood duration parameters:

    - Flood warning time of 25 hours for the 72-hour PMP

    - Flood inundation duration of 20 hours above the plant grade of 261 ft (79.55 m) for the 72-hour PMP

    - Flood recession duration of 32.5 hours for the 72-hour PMP

- The licensee has an existing contract in place with Accuweather, Inc. that requires notification of forecasts predicting greater than 1 in./hr (2.5 cm/hr) rainfall or greater than 6 in. (15 cm) of rainfall in a 24 hour period.

Staff agreed with the licensee's conclusion that the 72-hour PMP event results in the highest water surface elevation and longest period of inundation. However, as described in Section 3.2, the staff noted that PMP events shorter than 72-hour PMP result in (potentially significantly) shorter warning time and likewise results in a flood above the elevation of openings to plant structures. For example, a 6-hour PMP event results in an estimated flood warning time of less than one hour with a flood inundation duration of 14.5 hours above elevation 261 ft (79.55 m) (see Figure 4.0-1). Therefore, the staff determined that, as part of the Integrated Assessment Report, the licensee should evaluate the total plant response for a range of rainfall durations associated with the LIP hazard events (e.g., 1-, 6-, 12-, 24-, 48, 72-hour PMPs) to determine the controlling scenario(s) (see NRC, 2012c). This should include a sensitivity analysis to identify potentially limiting scenarios with respect to plant response when considering flood height, relevant associated effects, and flood event duration parameters. This is Integrated Assessment Action Item No. 2. Flood elevation duration parameters are provided for the 6-hour and 72-hour events in Table 4.0-1.

Based upon the preceding analysis, staff confirmed that the reevaluated flood hazard information defined in the sections above, with the exception of identified action items, is appropriate input to the integrated assessment. As described in the 50.54(f) letter, the licensee should submit the integrated assessment no later than two years from the date of the FHRR. The staff notes that action items as well as the bases for flood duration parameters (e.g., warning time based on existing agreements) may be further evaluated as part of the integrated assessment. Moreover, in light of the licensee's planned actions related to modification of site drainage features as described in Section 4.5 of the FHRR, the licensee may need to perform further site drainage evaluations as part of the integrated assessment.

5.0 CONCLUSION

The NRC staff has reviewed the information provided for the reevaluated flood-causing mechanisms for NMP Units 1 and 2. Based on its review, the staff concludes that the licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance used by the NRC staff in connection with ESP and COL reviews.

Based upon the preceding analysis, the NRC staff confirmed that the licensee responded appropriately to Enclosure 2, Required Response 2, of the 50.54(f) letter, dated March 12, 2012. In reaching this determination, the staff confirmed the licensee's conclusions that: (a) the reevaluated flood hazard result for local intense precipitation is not bounded by the current design basis flood hazard; (b) an Integrated Assessment including LIP flooding is expected to be submitted by the licensee; and (c) the reevaluated flood-causing mechanism information is appropriate input to the Integrated Assessment as described in JLD-ISG-2012-05 (NRC, 2012c). The NRC staff identified two Integrated Assessment Action Items related to the FLO-2D roof drain analysis and the assumptions to establishing conservative LIP flood warning times. The Integrated Assessment Open Items are summarized in Table 5.0-1. Therefore, the NRC is not providing finality on the flood parameters related to the local intense precipitation and associate site drainage as part of this staff assessment.

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Note: ADAMS Accession Nos. refer to documents available through NRC's Agencywide Documents Access and Management System (ADAMS). Publicly-available ADAMS documents may be accessed through http://www.nrc.gov/reading-rm/adams.html.

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Table 2.2-1: Flood-Causing Mechanisms and Corresponding Guidance

Flood-Causing Mechanism	SRP Section(s) and JLD-ISG
Local Intense Precipitation and Associated Drainage	SRP 2.4.2 SRP 2.4.3
Streams and Rivers	SRP 2.4.2 SRP 2.4.3
Failure of Dams and Onsite Water Control/Storage Structures	SRP 2.4.4 JLD-ISG-2013-01
Storm Surge	SRP 2.4.5 JLD-ISG-2012-06
Seiche	SRP 2.4.5 JLD-ISG-2012-06
Tsunami	SRP 2.4.6 JLD-ISG-2012-06
Ice-Induced	SRP 2.4.7
Channel Migrations or Diversions	SRP 2.4.9

Table 3.0-1: Summary of Datum Conversions for Oswego, all measurements given in ft (m)

	To				
From	**USLS35**	**IGLD55**	**IGLD85**	**NGVD29**	**NAVD88**
USLS35	0 (0)	-1.23 (-0.37)	-0.73 (-0.22)	-0.03 (-0.0\13)	-0.68 (-0.21)
IGLD55	1.23 (0.37)	0 (0)	0.5 (0.15)	1.2 (0.36)	0.55 (0.17)
IGLD85	0.73 (0.22)	-0.5 (-0.15)	0 (0)	0.7 (0.21)	0.05 (0.02)
NGVD29	0.03 (0.01)	-1.2 (-0.36)	-0.7 (-0.21)	0 (0)	-0.66 (-0.20)
NAVD88	0.68 (0.21)	-0.55 (-0.17)	-0.05 (-0.02)	0.66 (0.20)	0 (0)

Table 3.0-2: Summary of Controlling Flood-Causing Mechanisms

Reevaluated Flood-Causing Mechanisms and Associated Effects that May Exceed the Powerblock Elevation (elevation 261 ft (79.6 m))	**ELEVATION* (ft(m), USLS35)**
Local Intense Precipitation and Associated Drainage	262.2(77.92) for Unit 1 262.4 (77.98) for Unit 2

***Flood Height and Associated Effects as defined in JLD-ISG-2012-05.**

Table 3.1-1: Design Basis (DB) Flood Hazard

Flooding Mechanism	DB Still-Water Level (ft(m) USLS35)	DB Associated Effects (ft(m))	Current DB Flood Level (ft(m) USLS35)	Reference
Local Intense Precipitation and Associated Drainage	261.75 ft (79.78 m) for Unit 1 (IPEEE[4]) 262.5 ft (80.01 m) for Unit 2	Not Applicable	261.75 ft (79.78 m) for Unit 1 262.5 ft (80.01 m) for Unit 2	FHRR 1.3
Streams and Rivers	Not Discussed	Not Discussed in CDB	Not Discussed	FHRR 1.3
Failure of Dams and Onsite Water Control/Storage Structures	Not Discussed	Not Discussed	Not Discussed	FHRR 1.3
Storm Surge	254 ft (77.42 m) (Unit 2)	7 ft (2.1 m) due to wave run-up (Unit 2)	261 ft (79.55 m) (Unit 2)	FHRR 1.3 and UFSAR 2.4
Seiche	No Impact Identified	No Impact Identified	No Impact Identified	FHRR 1.3 and UFSAR 2.4
Tsunami	No Impact Identified	No Impact Identified	No Impact Identified	FHRR 1.3 and UFSAR 2.4
Ice-Induced	No Impact Identified	No Impact Identified	No Impact Identified	FHRR 1.3 and UFSAR 2.4
Channel Migrations or Diversions	No Impact Identified	No Impact Identified	No Impact Identified	FHRR 1.3 and UFSAR 2.4

Note: The plant grade for the NMP Units 1 and 2 is 261 ft (79.55 m) USLS35.

[4] Table 3.3-1 of the FHRR provides a comparison of the reevaluated flood elevation to the CLB flood elevation. Table 3.3-1 lists elevation "261.75 ft (IPEEE)" for the unit 1 CLB.

Table 3.3-1. PMF values for Lakeview Creek using simple equations (Kibler and Bliss (2013)).

Method	Equation	PMF (cfs(cms))
Myers (A>4 mi^2)	$Q=10000A^{0.5}$	22,159 (627.5)
Creager	$Q=46CA^D$, $D=0.894A^{-0.048}$	17,185 (486.6)
Northern Appalachian	$Q=8000A^{0.68}$	23,606 (668.4)
Harrison & Paxson	$Q=8148A^{0.69}$	24,429 (691.8)

Note: A is the watershed area in square miles (e.g., 4.91 mi^2 (12.7 km^2) for the Lakeview Creek basin), and C is a constant of 100.

Table 4.0-1: Flood Event Duration (see Figure 2.2-1) for Reevaluated Flood-Causing Mechanisms

Flood-Causing Mechanism	Site Preparation for Flood Event [Time Unit: hrs]	Period of Site Inundation [Time Unit: hrs]	Recession of Water from Site [Time Unit: hrs]
Local Intense Precipitation and Associated Drainage – 72-hour PMP	25 hours(1)	20 hours	32.5 hours
Local Intense Precipitation and Associated Drainage – 6-hour PMP	Less than one hour	14.5 hours	14 hours

(1) Refer to Integrated Assessment Action Item No. 2.

Table 4.0-2: Reevaluated Flood-Causing Mechanisms and Associated Effects Hazards

Reevaluated Flood-Causing Mechanism	Stillwater Elevation (ft(m) USLS35)	Associated Effects (ft(m))	Reevaluated Flood Hazard (ft(m) USLS35)	Reference
Local Intense Precipitation and Associated Drainage	262.2 (79.92) for Unit 1 262.4 (79.98) for Unit 2	Wind effect is not applicable	262.2 (79.92) for Unit 1 262.4 (79.98) for Unit 2	FHRR Section 3.2

Note: Site grade is 261 ft (79.55 m) USLS35.

Table 5.0-1: Integrated Assessment Action Items

Integrated Assessment Action Items: The Integrated Assessment Action Items set forth in the Staff Assessment and summarized in the table below identify certain matters that will be addressed in the Integrated Assessment submitted by the Licensee. These items constitute information requirements but do not form the only acceptable set of information. A licensee may depart from or omit these items, provided that the departure or omission is identified and justified in the Integrated Assessment. In addition, these items do not relieve a licensee from any requested information described in Part 2, Integrated Assessment, of the March 12, 2012, 10 CFR 50.54(f) letter, Enclosure 2.

Action Item No.	SA Section No.	Subject to be Addressed
1	3.2	The licensee is requested to resolve the staff-identified numerical modeling issue associated with the local intense precipitation flood analyses. This issue relates to runoff from rooftops being removed from the numerical model domain rather than discharging to the ground surface near the structure or an adjacent area.
2	4.0	The licensee is requested to evaluate the total plant response time considering a range of rainfall durations associated with the local intense precipitation flood hazard (e.g., 1-, 6-, 12-, 24-, 48, 72-hour PMPs). This evaluation should identify potentially limiting scenarios with respect to plant response when considering flood height, relevant associated effects, and flood-event duration parameters.

Figure 2.2-1: Flood Event Duration

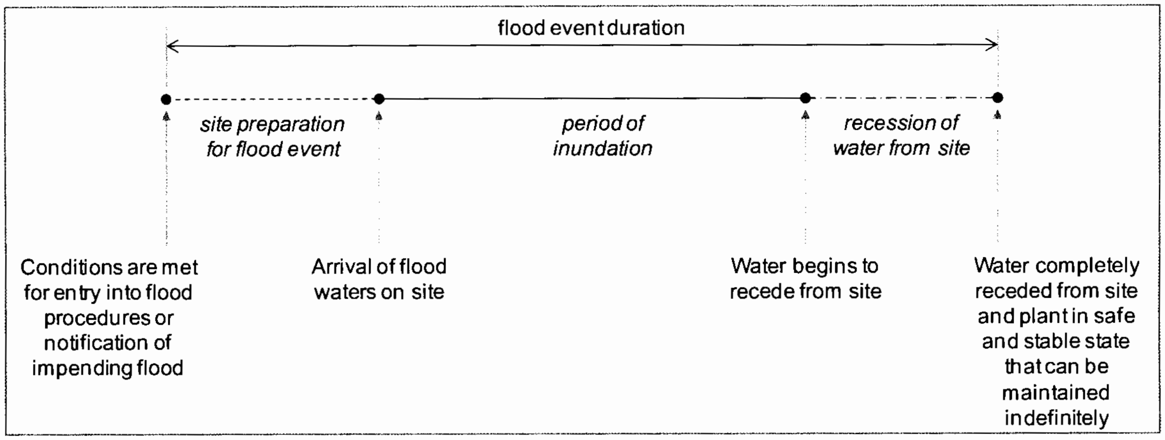


Figure 3.1-1. NMP Units 1 & 2 site layout (modified from FHRR Figure 1.2-1).

Figure 3.4-1. Oswego River Watershed basin with the location of the site (red square) and dams (blue dots).

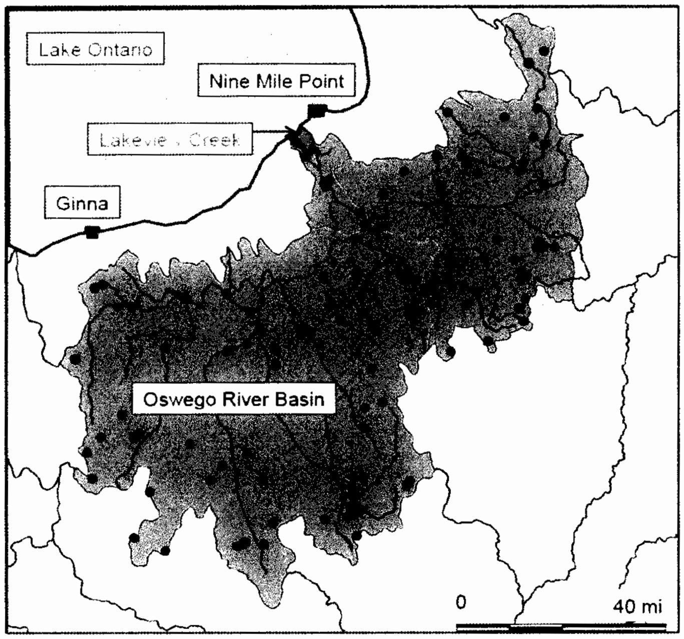
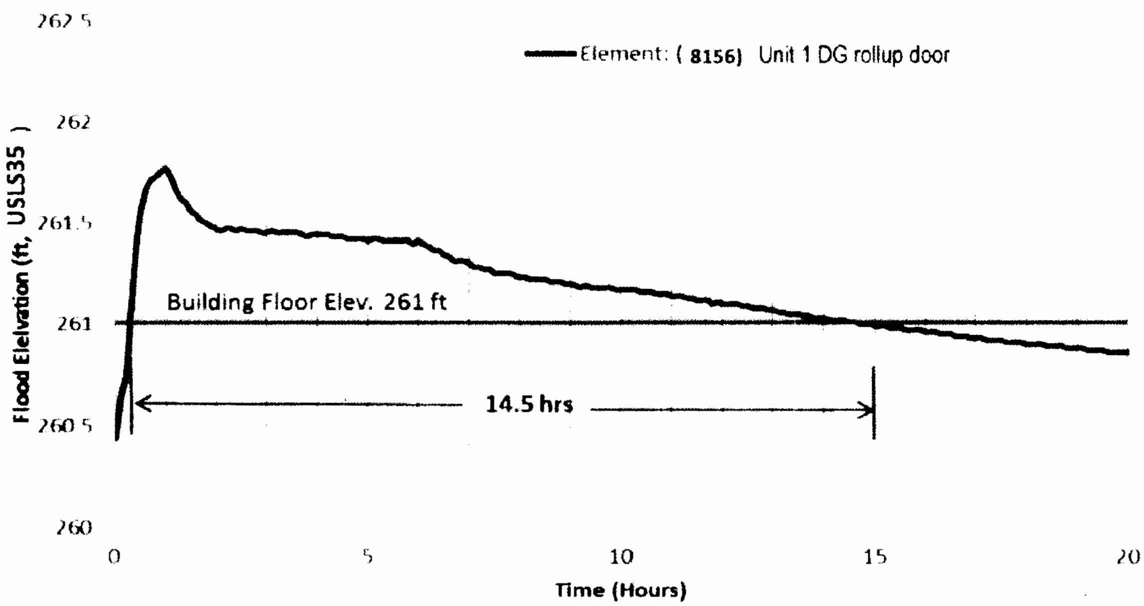


Figure 4.0-1. Time Series of Water Surface Elevation at Element 8156 Unit 1 – 6-hour PMP (from the FHRR Figure 2.1-14).



If there are any questions, please contact me at (301) 415-3733 or email at Robert.Kuntz@nrc.gov.

Sincerely,

/RA/

Robert F. Kuntz, Senior Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos.: 50-220, and 50-410

Enclosures:
Staff Assessment of Flood Hazard Reevaluation Report

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