UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON D C 20555-0001

November 04, 2016

Mr. C.R. Pierce
Regulatory Affairs Director
Southern Nuclear Operating Co., Inc.
P.O. BOX 1295 / BIN B038
Birmingham, AL 35201-1295

SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2 – STAFF ASSESSMENT OF RESPONSE TO 10 CFR 50.54(f) INFORMATION REQUEST – FLOOD-CAUSING MECHANISM REEVALUATION (CAC NOS. MF7039 AND MF7040)

Dear Mr. Pierce:

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 that licensees reevaluate flood-causing mechanisms using present-day methodologies and guidance. By letter dated October 21, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15294A530, non-public), Southern Nuclear Operating Company, Inc. (the licensee) responded to this request for Joseph M. Farley Nuclear Plant, Units 1 and 2 (Farley).

By letter dated December 10, 2015 (ADAMS Accession No. ML15343A418), the NRC staff sent the licensee a summary of the staff's review of Hatch's reevaluated flood-causing mechanisms. The enclosed staff assessment provides the documentation supporting the NRC staff's conclusions summarized in the letter. As stated in the letter, the reevaluated flood hazard results for several effects, including local intense precipitation (LIP), were not bounded by the current design-basis flood hazard. In order to complete its response to Enclosure 2 to the 50.54(f) letter, the licensee is expected to submit a focused evaluation for LIP and additional assessments for the other effects specified in the letter to address this reevaluated flood hazard, as described in an NRC letter issued September 1, 2015 (ADAMS Accession No. ML15174A257). This closes out the NRC's efforts associated with CAC Nos. MF7039 AND MF7040.

| |
|---|
| Enclosure 1 transmitted herewith contains security-related information. When separated from Enclosure 1, this document is decontrolled. |

If you have any questions, please contact me at (301) 415-1056 or e-mail at Lauren.Gibson@nrc.gov.

Sincerely,

Lauren Kate Gibson

Lauren Gibson, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos. 50-348 and 50-364

Enclosures:
1. Staff Assessment of Flood Hazard Reevaluation Report (non-public, security-related information)
2. Staff Assessment of Flood Hazard Reevaluation Report (public)

cc w/encl: Distribution via Listserv

# STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO FLOODING HAZARD REEVALUATION REPORT NEAR-TERM TASK FORCE RECOMMENDATION 2.1 JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2 DOCKET NOS. 50-348 AND 50-364

## 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 Licenses" (hereafter referred to as the "50.54(f) letter"). The request in connection with the implementation of the lessons-learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant as documented in the NRC's Near-Term Task Force Report (NRC, 2011b). 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 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 (NRC, 2012a) requested that licensees reevaluate the flood hazard 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 the NRC staff would provide a prioritization plan indicating Flooding Hazard Reevaluation Report (FHRR) deadlines for each plant. On May 11, 2012, the staff issued its prioritization of the FHRRs (NRC, 2012c).

If the reevaluated hazard for any flood-causing mechanism is not "bounded" by the plant's current design-basis (CDB) flood hazard, an additional assessment of plant response is necessary, as described in the 50.54(f) letter and COMSECY-15-0019, "Mitigating Strategies and Flooding Hazard Reevaluation Action Plan" (NRC, 2015a).

Additionally, for any reevaluated flood hazards that are not bounded by the plant's CDB hazard, the licensee is expected to develop flood event duration (FED) parameters and associated effects (AE) to conduct the mitigating strategies assessment (MSA) and focused evaluations or revised integrated assessments.

By letter dated March 12, 2015 (SNC, 2015a), Southern Nuclear Operating Company, Inc. (SNC, the licensee) provided its FHRR for Joseph M. Farley Nuclear Plant (Farley), Units 1 and 2. The licensee supplemented its response by letter dated November 2, 2015 (SNC, 2015b). In connection with the March response, the licensee identified certain interim actions. The licensee stated in its FHRR that interim actions and procedures currently exist to ensure that the plant will be safe during a flood event, and that interim actions and procedures will be reevaluated and updated as determined by a focused evaluation and/or an additional assessment. The licensee also stated that interim actions and procedures have been finalized for local intense precipitation (LIP) and for failure of dams and onsite water control structures with and without combined effects to mitigate the beyond-design-basis values for the unbounded hazards.

On December 10, 2015, the NRC issued an interim staff response (ISR) letter to the licensee (NRC, 2015b). The purpose of the ISR letter is to provide the flood hazard information suitable for the assessment of mitigating strategies developed in response to Order EA-12-049 "Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (NRC, 2012b) and the additional assessments associated with Recommendation 2.1: Flooding. The ISR letter also referred to this staff assessment, which documents the NRC staff's basis and conclusions. The flood hazard mechanism values presented in the letter's enclosures match the values in this staff assessment without change or alteration.

As mentioned in the ISR letter and discussed below, the reevaluated flood hazard results for the LIP, and failure of dams and onsite water control structures flood-causing mechanisms are not bounded by the plant's CDB hazard. Consistent with the 50.54(f) letter and amended by the process outlined in COMSECY-15-0019 and JLD-ISG-2016-01, Revision 0 (NRC, 2015a; NRC, 2016c), the staff anticipates that for LIP, the licensee will perform and document a focused evaluation to assess the impact of the LIP hazard on the site. Additionally, for the dam failure flood-causing mechanism, the staff anticipates that the licensee will submit (1) a revised integrated assessment or (2) a focused evaluation confirming the capability of existing flood protection or implementing new flood protection consistent with the process outlined in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

## 2.0 REGULATORY BACKGROUND

### 2.1 Applicable Regulatory Requirements

As stated above, Enclosure 2 to the 50.54(f) letter requested that the licensee reevaluate flood hazards at their site(s) 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.

Sections 50.34(a)(1), (a)(3), (a)(4), (b)(1), (b)(2), and (b)(4), of 10 CFR, describe the required content of the preliminary and final safety analysis report, 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.

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 design bases 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 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 updated final safety analysis report (UFSAR). The licensee's commitments made in docketed licensing correspondence that 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 site 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

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 (NRC, 2012a) requested, in part, that 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.

### 2.2.1 Flood-Causing Mechanisms

Enclosure 2 of the 50.54(f) letter (NRC, 2012a) discusses the flood-causing mechanisms that licensees should address in the FHRR. Table 2.2-1 lists the flood-causing mechanisms that the licensee should consider. Table 2.2-1 also lists the corresponding Standard Review Plan (SRP) (NRC, 2007) sections and applicable interim staff guidance (ISG) documents containing acceptance criteria and review procedures.

### 2.2.2 Associated Effects

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

- Wind waves and runup 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, "Areas of Review" (NRC, 2007)). Attachment 1 of the 50.54(f) letter describes the "combined effect flood," 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), 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 are plausible combined events and should be considered.

### 2.2.4 Flood Event Duration

Flood event duration was defined in JLD-ISG-2012-05 (NRC, 2012d) as the length of time during which the flood event affects the site. It begins when conditions are met for entry into a flood 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 CDB flood hazard for all flood-causing mechanisms, the 50.54(f) letter (NRC, 2012a) 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 to: (a) evaluate the effectiveness of the CLB (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 CDB flood hazard for each flood-causing mechanism at the site, licensees are not required to perform an integrated assessment.

COMSECY-15-0019 (NRC, 2015a) and associated guidance outline a revised process for addressing cases in which the reevaluated flood hazard is not bounded by the plant's CDB. The revised process describes an approach in which licensees with a LIP hazard exceeding their CDB flood will not be required to complete an integrated assessment, but would instead perform a focused evaluation. As part of the focused evaluation, licensees will assess the impact of the LIP hazard on their sites and then evaluate and implement any necessary programmatic, procedural, or plant modifications to address the hazard exceedance. For other flood hazard mechanisms that exceed the CDB, licensees can assess the impact of these reevaluated hazards on their site by performing either a focused evaluation or an integrated assessment (NRC, 2015a), consistent with JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation" (NRC, 2016c).

## 3.0 TECHNICAL EVALUATION

The NRC staff reviewed the information provided for the flood hazard reevaluation of Farley, 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.

To provide additional information in support of the summaries and conclusions in the Farley FHRR (SNC, 2015a), the licensee made several calculation packages available to the staff via DVDs. The staff's review and evaluation are provided below.

The Farley FHRR (SNC, 2015a) provided elevations in two datums, the North American Vertical Datum of 1988 (NAVD88) and the National Geodetic Vertical Datum of 1929 (NGVD29), also referred to as mean sea level (MSL). The conversion factor from NAVD88 to NGVD29 to is 0.33 ft (0.10 m). Unless otherwise stated, all elevations in this document are given with respect to NGVD29.

### 3.1 Site Information

The 50.54(f) letter (NRC, 2012a) requested that relevant SSCs important to safety be included in the scope of the hazard reevaluation. The licensee included this pertinent data concerning these SSCs in the FHRR (SNC, 2015a). The staff reviewed and summarized this information as follows in the sections below.

#### 3.1.1 Detailed Site Information

The Farley site (Figure 3.1-1) is located along the west side of the Chattahoochee River in Houston County, Alabama. The site is approximately 460 acres (1.862 km$^2$) in size and varies in elevation from 120 ft (36.6 m) at the river to 210 ft (64.0 m). With the exceptions of Atlanta and Columbus, Georgia, Chattahoochee River Watershed is mostly rural with deciduous and evergreen forest.

Drainage from the site is primarily in three directions, north into Wilson Creek (a small tributary located adjacent to the plant), and east and south toward the Chattahoochee River. There is a north-south topographic divide west of the power block. The power block area drains east and then to the north and south via concrete channels and culverts.

The power block area shown in Figure 3.1-2 is at elevation 154.5 ft (47.09 m). The service water intake structure, which is located south of the power block area, is at elevation 195.0 ft (59.44 m).

### 3.1.2 Design-Basis Flood Hazards

The CDB flood levels are summarized by flood-causing mechanism in Table 3.1-1. The NRC staff reviewed the information provided in the Farley FHRR (SNC, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

### 3.1.3 Flood-Related Changes to the Licensing Basis

The licensee stated that there had been no changes to the licensing basis since the last revision of the UFSAR (SNC, 2015a). The NRC staff reviewed the information provided in the Farley FHRR (SNC, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

### 3.1.4 Flood Protection Changes since License Issuance

A deficiency in the service water culvert due to partial blockage was identified during the flood walkdown and subsequently corrected (SNC, 2015a). The NRC staff reviewed the information provided in the Farley FHRR (SNC, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

### 3.1.5 Changes to the Watershed and Local Area

A new spillway was added to increased spillway capacity at the Bartletts Ferry reservoir (SNC, 2015a). The NRC staff reviewed the information provided in the Farley FHRR (SNC, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

### 3.1.6 Current Licensing Basis Flood Protection and Pertinent Flood Mitigation Features

Farley is protected from both LIP and river flooding due to the topography and the drainage system at the site. The licensee stated in its FHRR that including dam break and wave runup, the maximum water surface elevation would remain below the site grade of 154.5 ft (47.09 m) (SNC, 2015a). Additionally, the licensee stated that all safety-related systems and components located below the design maximum flood elevation are protected against flooding.

The ultimate heat sink pond for Farley is located south of the power block area and is a seismic Category 1 structure. Farley is protected from flooding caused by an assumed failure of the pond due to its location and the topography of the immediate area (SNC, 2015a).

Farley does not rely on any active or temporary flood protection features (SNC, 2015a). The site uses Kontek vehicle barriers to protect safety-related buildings against moving vehicles.

Although not their intended function, these barriers also provide protection for the safety-related buildings against wind-generated waves.

The NRC staff reviewed the information provided in the Farley FHRR (SNC, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

### 3.1.7 Additional Site Details to Assess the Flood Hazard

The licensee provided electronic copies of input files related to flood hazard reevaluations (SNC, 2015b).

### 3.1.8 Results of Plant Walkdown Activities

The 50.54(f) letter requested that licensees plan and perform plant walkdown activities to verify that current flood protection systems are available, functional, and implementable. Other parts of the 50.54(f) letter asked the licensee to report any relevant information from the results of the plant walkdown activities.

By letter dated November 27, 2012, the licensee provided the flood walkdown report for Farley (SNC, 2012). The staff prepared a staff assessment report, dated June 3, 2014 (NRC, 2014), to document its review of the walkdown report. The NRC staff concluded that the licensee's implementation of the flooding walkdown methodology met the intent of the walkdown guidance.

## 3.2 Local Intense Precipitation and Associated Site Drainage

The licensee reported in its FHRR that the reevaluated flood hazard for LIP is based on a maximum stillwater-surface elevation that ranged from 155.2 ft (47.30 m) to 156.0 ft (47.55 m) in the power block area and 195.8 ft (59.68 m) at the service water intake structure.

This flood-causing mechanism is discussed in the licensee's CDB. The CDB (stillwater) from LIP and associated site drainage corresponds to 6 inches (15.24 cm) of depth outside of the turbine building (SNC, 2015a).

### 3.2.1 Model Inputs

The licensee used FLO-2D for their LIP analysis. FLO-2D is a two-dimensional hydrodynamic model that uses shallow water equations to route storm water over the site. Information used for creating the model inputs were digital elevation models (DEM) developed from light detection and ranging (LiDAR) along with records, such as as-built drawings and new surveys of the site.

Vehicle barriers were modeled in FLO-2D as levees to account for their effect on the flow paths. Openings in the levees were included to account for roadways; however, based on site walk downs, the existing topography, and site grading, there were no gaps included in the modeled levees (SNC, 2015a).

The licensee used Manning's roughness coefficients of 0.32 for dense grass and vegetation, 0.35 - 0.40 for shrubs and pasture, 0.035 for asphalt or concrete, 0.03 for buildings, 0.05 for gravel, and 0.02 for water surfaces to account for friction losses (SNC, 2015b).

The licensee relied on NUREG/CR-7046, "Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America" (NRC, 2011e), and the National Weather Service's "Application of Probable Maximum Precipitation Estimates – United States East of the 105$^{th}$ Meridian," Hydrometeorological Report No. 52 (HMR-52) (NOAA, 1982).

Using the guidance mentioned above, the licensee developed a 1-hour duration and 1-mi$^2$ (3-km$^2$) area probable maximum precipitation (PMP) with a cumulative depth of 19.3 inches (49 cm) for the Farley site. The licensee used the front loaded temporal distribution from HMR-52. A simulation time period of 24 hours was used to allow the site to drain and to identify remaining ponding areas onsite (SNC, 2015a).

3.2.2 Site Drainage

For the LIP analysis, the licensee assumed all drainage system components were either non-functional or clogged during the event and ignored losses from infiltration (SNC, 2015a).

3.2.3 Hydraulic Model Results

The FLO-2D model outputs for maximum water surface elevations, depths, and velocities were provided by the licensee in the FHRR. The reevaluated water surface elevations are tabulated for various buildings, and other locations of interest such as door openings in Table 4.1-1. The approaches used to develop the inputs to the FLO-2D model were reviewed by the NRC staff and were found to be with current and accepted methods. Additionally, staff performed a confirmatory FLO-2D model run of the LIP scenario provided by the licensee and confirmed the licensee's results.

3.2.4 Conclusion

The staff confirmed the licensee's reevaluation of the hazard from LIP used present-day methodologies and regulatory guidance. The NRC staff also confirmed the licensee's conclusion that the reevaluated flood hazard for LIP was a maximum stillwater-surface elevation that ranged from 155.2 ft (47.30 m) to 156.0 ft (47.55 m) in the power block area and 195.8 ft (59.68 m) at the service water intake structure, which is not bounded by the CDB flood hazard. Therefore, the staff expects that the licensee will submit a focused evaluation for LIP consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

3.3 Streams and Rivers

The reevaluated flooding hazard for Farley is divided into two different analyses: Chattahoochee River probable maximum flood (PMF) and Wilson Creek PMF (SNC, 2015a). This flood-causing mechanism is discussed in the licensee's CDB. The CDB PMF elevation for streams and rivers is based on a water surface elevation of 153.3 ft (46.73 m), including 9.1 ft (2.77 m) of runup from wind waves (SNC, 2015a).

3.3.1 Chattahoochee River

Per Interagency Agreement NRC-HQ-13-I-03-0021, the USACE assisted the NRC in determining the safety significance of hydrologic and geotechnical issues and other features associated with dams that may affect the safe, reliable operation of downstream or nearby nuclear power plants. The USACE report (USACE, 2015) estimated the PMF in the Chattahoochee River near the Farley site to be approximately 664,000 cubic feet per second (cfs) (18,800 cubic meters per second ($m^3/s$)), which corresponds to a flood height of 141.5 ft (43.13 m). The licensee adopted these values in the FHRR.

3.3.2 Wilson Creek

The licensee used the methods provided in Hydrometerological Report 51 (HMR-51) (NOAA, 1978) and HMR-52 (NOAA, 1982) to estimate the PMP for the Wilson Creek Watershed. For conservatism, the value estimated for the storm center was applied to the entire watershed. The licensee determined the peak discharge of 32,458 cfs (919.1 $m^3/s$) in Wilson Creek, and a flood height near the site of 140.5 ft (42.82 m) (SNC, 2015a).

The licensee used Snyder's Method within Hydrologic Engineering Center - Hydrologic Modeling System (HEC-HMS) to estimate the peak runoff from the PMP for the 8 square miles (20.7 $km^2$) Wilson Creek watershed. The licensee modeled the watershed for Wilson Creek in the HEC-HMS model with three sub-basins. Three storm durations (6 hour, 12 hour, and 24 hour) were considered with the 24-hour duration generating the highest discharge (SNC, 2015a).

The maximum water surface elevation near the site was estimated by the licensee using a steady-flow HEC-RAS model of Wilson Creek. Topographic information was taken from LiDAR data and a 10 meter USGS DEM. Details for the bridge crossing Wilson Creek were obtained from design drawings, and were incorporated into the HEC-RAS model. The licensee used orthoimagery of the area to assign Manning's Roughness coefficients. The maximum water surface elevation near the site was estimated to be 140.5 ft (42.82 m). Runup from wind waves was not considered for this calculation (SNC, 2015a).

The NRC staff examined the inputs to both the HEC-HMS and HEC-River Analysis System (RAS) models and also performed confirmatory calculations and found the licensee's methods and results to be reasonable.

3.3.3 Conclusion

Based on review of the licensee's information provided for the PMF analysis, the NRC staff agrees with the licensee's reevaluated still-water PMF flood elevation for flooding from streams and rivers to be 141.5 ft (43.13 m). The staff confirms the licensee's conclusion that the reevaluated hazard for flooding from river and streams is bounded by the CDB. Therefore, flooding from rivers and streams does not need to be analyzed in a focused evaluation or a revised integrated assessment as discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

3.4 Failure of Dams and Onsite Water Control/Storage Structures

The licensee reported in its FHRR that the reevaluated flood hazard analysis for failure of dams and onsite water control or storage structures is based on a stillwater-surface elevation of [redacted] or [redacted] including wave runup. This flood-causing mechanism is discussed in the licensee's CDB. The CDB for failure of dams and onsite water control structures is [redacted], including [redacted] of wave runup. (SNC, 2015a).

Per Interagency Agreement NRC-HQ-13-I-03-0021, the USACE assisted the NRC in determining the safety significance of hydrologic and geotechnical issues and other features associated with dams that may affect the safe, reliable operation of downstream or nearby nuclear power plants. The USACE report (USACE, 2015) estimated the peak discharge due to dam failure upstream of the Farley site to be approximately [redacted] which corresponds to a flood height of [redacted] The licensee adopted these values in the FHRR.

To satisfy Attachment 1 of the 50.54(f) letter describing the "combined effect flood", the licensee added the effect of wind wave to the maximum still-water water surface elevation from dam failure using ANSI/ANS 2.8-1992 (ANSI/ANS, 1992). The licensee estimated the 2-year wind speed to be 50 mph. Using ANSI/ANS 2.8-1992 (ANSI/ANS, 1992), USACE EM 110-2-100 (USACE, 2008), USACE CERC-90-4 (USACE, 1990), and USACE EM-1110-2-1420 (USACE, 1997), the licensee estimated the maximum water surface elevation to be [redacted]

The NRC staff reviewed the methodology and calculations including the fetch lengths, significant wave height parameters, wind setup parameters, breaking wave parameters, and the maximum water surface elevations calculations and finds them to be appropriate for meeting current regulatory guidance using present-day methods.

The staff reviewed the licensee's methodology for the PMF analysis and concludes that the methods are appropriate for the purposes of the 50.54(f) letter. The staff confirmed the licensee's conclusion that the reevaluated flood hazard for failure of dams and onsite water control structures of [redacted] is not bounded by the CDB flood hazard. Therefore, the NRC staff expects that the licensee will submit a focused evaluation for failure of dams and onsite water control structures with and without combined effects or a revised integrated assessment consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

### 3.5 Storm Surge

This flood-causing mechanism is not discussed in the licensee's CDB. The licensee reported that the Farley site is located upstream of tidal influences and is not subject to flooding from storm surge (SNC, 2015a).

The NRC staff reviewed the information provided by the licensee and agrees that a storm surge event at the site is not likely and therefore will not impact the site. The staff confirmed the licensee's conclusion that storm surge is not a plausible flooding mechanism at the Farley site. Therefore, flooding from storm surge does not need to be analyzed in a focused evaluation or a revised integrated assessment as discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

### 3.6 Seiche

This flood-causing mechanism is not discussed in the licensee's CDB. The licensee reported that the Farley site is located on the Chattahoochee River, which is not subject to flooding from seiche (SNC, 2015a).

The NRC staff reviewed the information provided by the licensee, and agrees that a seiche event at the site is not likely and therefore will not impact the site. The staff confirmed the licensee's conclusion that seiche is not a plausible flooding mechanism at the Farley site. Therefore, flooding from seiche does not need to be analyzed in a focused evaluation or a revised integrated assessment as discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

### 3.7 Tsunami

This flood-causing mechanism is not discussed in the licensee's CDB. The licensee reported that the Farley site is located upstream of tidal influences and is not subject to flooding from tsunami (SNC, 2015a).

The NRC staff reviewed the information provided by the licensee, and agrees that a tsunami only event at the site is not likely and therefore will not impact the site. The staff confirmed the licensee's conclusion that tsunami is not a plausible flooding mechanism at the Farley site. Therefore, flooding from tsunami does not need to be analyzed in a focused evaluation or a revised integrated assessment as discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

### 3.8 Ice-Induced Flooding

This flood-causing mechanism is not discussed in the licensee's CDB. The licensee noted in the Farley FHRR that there have not been any recorded incidences of ice near the plant site or ice-induced flooding. The licensee noted that ice has formed along the shore, but does not form ice jams on the main river reservoirs.

The staff independently searched the USACE Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database (USACE, n.d.-a) for current and historical ice jams near Farley site and found no current or historical ice jams in the vicinity. Therefore, the NRC staff agrees that there are no flooding impacts from ice-induced events near the Farley site. The staff reviewed the licensee's findings in the Farley FHRR and confirmed the licensee's conclusion that ice-induced flooding is not a plausible flooding mechanism at the Farley site. Therefore, ice-induced flooding does not need to be analyzed in a focused evaluation or a revised integrated assessment as discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

### 3.9 Channel Migrations or Diversions

The licensee reported in the Farley FHRR that channel migrations or diversions was screened out of the current licensing basis (SNC, 2015a).

The staff reviewed the basin topography and noted there was no evidence of channel migration or diversion along nearby streams or tributaries that could threaten the site. The NRC staff reviewed the information provided by the licensee and confirms the licensee's conclusion that the flood hazard from channel migrations or diversions is not a plausible flooding mechanism at the Farley site. Therefore, flooding from channel migrations or diversions does not need to be analyzed in a focused evaluation or a revised integrated assessment as discussed in COMSECY-15-0019 (NRC, 2015a), and associated guidance.

# 4.0 REEVALUATED FLOOD HEIGHT, EVENT DURATION, AND ASSOCIATED EFFECTS FOR HAZARDS NOT BOUNDED BY THE CDB

## 4.1 Reevaluated Flood Height for Hazards Not Bounded by the CDB

Section 3 of this staff assessment documents the staff review of the licensee's flood hazard water height results. Table 4.1-1 contains the maximum results, including waves and runup, for flood mechanisms not bounded by the CDB presented in Table 3.1.1. The staff agrees with the licensee's conclusion that LIP and failure of dams and onsite water control structures (including combined effects) are the hazard mechanisms not bounded by the CDB.

Consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a) and JLD-ISG-2016-01, Revision 0 (NRC, 2016b), NRC staff anticipates the licensee will submit a focused evaluation for LIP. For the failure of dams and onsite water control structures flood-causing mechanism, NRC staff anticipates the licensee will perform additional assessments of plant response, either a focused evaluation or a revised integrated assessment, as discussed in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

## 4.2 Flood Event Duration for Hazards Not Bounded by the CDB

The NRC staff reviewed information provided in Farley's 50.54(f) response (SNC, 2015a) regarding the FED parameters needed to perform the additional assessments of plant response 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 4.2-1.

The licensee provided a FED parameter of 24 hours for available warning time for LIP. This parameter is based on the local weather forecast. The NRC staff reviewed the value for this parameter and found it to be acceptable based on NRC-endorsed industry guidance (NEI, 2015b).

The licensee did not provide FED parameters for failure of dams and onsite water control structures (including combined effects). The licensee is expected to develop FED parameters to conduct the MSA and focused evaluations or revised integrated assessments as discussed in in COMSECY-15-0019 (NRC, 2015a) and associated guidance.

## 4.3 Associated Effects for Hazards Not Bounded by the CDB

The staff reviewed information provided in SNC's 50.54(f) response (SNC, 2015a) regarding AE parameters needed to perform future additional assessments of plant response for flood hazards not bounded by the CDB. The AE parameters directly related with maximum total water height, such as waves and runup, are summarized in Section 4.1 of this staff assessment. The AE parameters not directly associated with total water height are listed in Table 4.3-1. The AE parameters were not submitted as part of the FHRR and are noted as "not provided" in this table. The NRC staff will review these AE parameters as part of future additional assessments of plant response, if applicable to the assessment and hazard mechanism. The licensee is expected to develop AE parameters for LIP and dams on onsite water structures to conduct the MSA and focused evaluations or revised integrated assessments as discussed NEI-12-06 (Revision 2), Appendix G (NEI, 2015a), and outlined in COMSECY-15-0019 (NRC, 2015a), and associated guidance.

### 4.4 Conclusion

Based upon the preceding analysis, NRC staff confirms that the reevaluated flood hazard information discussed in Section 4 is appropriate input to the additional assessments of plant response as described in the 50.54(f) letter (NRC, 2012a), COMSECY-15-0019 (NRC, 2015a), and the associated guidance.

The licensee is expected to develop FED parameters and applicable flood AEs to conduct the MSA as discussed in the NEI 12-06 (Revision 2), Appendix G (NEI, 2015a). The staff will evaluate FED parameters and flood-related AE marked as "not provided" in Tables 4.2-1 and 4.3-1 during its review of the MSA and focused evaluations or revised integrated assessments.

## 5.0 CONCLUSION

The NRC staff has reviewed the information provided for the reevaluated flood-causing mechanisms of Farley, Units 1 and 2. Based on the review of the above available information provided in SNC's 50.54(f) response (SNC, 2015a), 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, staff confirmed the licensee's conclusions that: (1) the reevaluated flood hazard results for LIP and failure of dams and onsite water control structures (with and without combined effects) is not bounded by the CDB flood hazard; (2) additional assessments of plant response will be performed for LIP and for failure of dams and onsite water control structures (with and without combined effects); and (3) the reevaluated flood-causing mechanism information is appropriate input to the additional assessments of plant response as described in the 50.54(f) letter and COMSECY-15-0019 (NRC, 2015a) and associated guidance. The NRC staff has no additional information needs at this time with respect to SNC's 50.54(f) response.

## 6.0 REFERENCES

Notes: ADAMS Accession Nos. refers 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.

U.S. Nuclear Regulatory Commission Documents and Publications

NRC (U.S. Nuclear Regulatory Commission), 2007, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition", NUREG-0800, 2007. ADAMS stores the Standard Review Plan as multiple ADAMS documents, which are accessed through NRC's public web site at http://www.nrc.gov/reading-rm/basic-ref/srp-review-standards.html.

NRC, 2011a, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," Commission Paper SECY-11-0093, July 12, 2011, ADAMS Accession No. ML11186A950.

NRC, 2011b, "Recommendations for Enhancing Reactor Safety in the 21st Century: The Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," Enclosure to Commission Paper SECY-11-0093, July 12, 2011, ADAMS Accession No. ML111861807.

NRC, 2011c, "Recommended Actions to be Taken Without Delay from the Near-Term Task Force Report," Commission Paper SECY-11-0124, September 9, 2011, ADAMS Accession No. ML11245A158.

NRC, 2011d, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," Commission Paper SECY-11-0137, October 3, 2011, ADAMS Accession No. ML11272A111.

NRC, 2011e, "Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United State of America," NUREG/CR-7046, November 2011, ADAMS Accession No. ML11321A195.

NRC, 2012a, letter from Eric J. Leeds, Director, Office of Nuclear Reactor Regulation and Michael R. Johnson, Director, Office of New Reactors, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding the Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident", March 12, 2012, ADAMS Accession No. ML12053A340.

NRC, 2012b, letter from Eric J. Leeds, Director, Office of Nuclear Reactor Regulation and Michael R. Johnson, Director, Office of New Reactors, to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events", Order EA-12-049, March 12, 2012, ADAMS Accession No. ML12054A736.

NRC, 2012c, letter from Eric J. Leeds, Director, Office of Nuclear Reactor Regulation, to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, "Prioritization of Response Due Dates for Information Pursuant to 10 CFR 50.54(f) Regarding Flooding Hazard Reevaluations for Rec. 2.1 of the NTTF Review of Insights from the Fukushima Dai-ichi Accident." May 11, 2012, ADAMS Accession No. ML12097A510.

NRC, 2012d, "Guidance for Performing the Integrated Assessment for External Flooding," Japan Lessons-Learned Project Directorate, Interim Staff Guidance JLD-ISG-2012-05, Revision 0, November 30, 2012, ADAMS Accession No. ML12311A214.

NRC, 2013a, "Guidance for Performing a Tsunami, Surge, or Seiche Hazard Assessment," Japan Lessons-Learned Project Directorate, Interim Staff Guidance JLD-ISG-2012-06, Revision 0, January 4, 2013, ADAMS Accession No. ML12314A412.

NRC, 2013b, "Guidance For Assessment of Flooding Hazards Due to Dam Failure," Japan Lessons-Learned Project Directorate, Interim Staff Guidance JLD-ISG-2013-01, Revision 0, July 29, 2013, ADAMS Accession No. ML13151A153.

NRC, 2014, "Staff Assessment of Flooding Walkdown Report, Near-Term Task Force Recommendation 2.3 Related to the Fukushima Dai-Ichi Nuclear Power Plant Accident, Southern Nuclear, Joseph M. Farley Nuclear Plant, Units 1 and 2, Docket Nos. 50-348, 50-364," June 3, 2014, ADAMS Accession No. ML14128A083.

NRC, 2015a "Closure Plan for the Reevaluation of Flooding Hazards for Operating Nuclear Power Plants," Commission Paper COMSECY-15-0019, June 30, 2015, ADAMS Accession No. ML15153A104.

NRC, 2015b, Joseph M. Farley Nuclear Plant, Units 1 and 2 - Interim Staff Response To Reevaluated Flood Hazards Submitted In Response to 10 CFR 50.54(F) Information Request - Flood-Causing Mechanism Reevaluation (TAC Nos. MF7039 and MF7040)." December 10, 2015. ADAMS Accession No. ML15343A418.

NRC, 2016a, "Compliance with Order EA-12-049 Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events", Interim Staff Guidance JLD-ISG-2012-01, Revision 1 and Comment Resolution, January 22, 2016, ADAMS Accession No. ML15357A142.

NRC, 2016b, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation; Focused Evaluation and Integrated Assessment, "Interim Staff Guidance JLD-ISG-2016-01, Revision 0, July 11, 2016, ADAMS Accession No. ML16162A301.

<u>Codes and Standards</u>

ANSI/ANS (American National Standards Institute/American Nuclear Society), 1992, ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites," American Nuclear Society, LaGrange Park, IL, July 1992.

<u>Other References</u>

NEI (Nuclear Energy Institute), 2015, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 2. NEI 12-06, December 2015. ADAMS Accession No. ML16005A625.

NEI white paper, "Warning Time for Maximum Precipitation Events" as endorsed by the NRC on April 23, 2015 (ADAMS Accession No. ML15110A080).

NOAA (National Oceanic and Atmospheric Administration), 1978, "Probable Maximum Precipitation Estimates, United States, East of the 105th Meridian," Hydrometeorological Report No. 51, June 1978.

NOAA, 1982, "Application of Probable Maximum Precipitation Estimates, United States, East of the 105th Meridian," NOAA Hydrometeorological Report No. 52, August 1982. Available online at http://nws.noaa.gov/oh/hdsc/PMP_documents/HMR52.pdf.

Southern Nuclear Operating Company, Inc. (SNC), 2012, "Joseph M. Farley, Units 1 & 2, Flooding Recommendation 2.3 Walkdown Report Requested by NRC Letter, Request for Information Pursuant to 10 CFR 50.54(f) Re: Recommendations 2.1, 2.3, and 9.3, of Near-Term Task Force Review of Insights from Fukushima." November 27, 2012, ADAMS Accession No. ML12333A146.

SNC, 2015a, "Joseph M. Farley, Units 1 and 2, Recommendation 2.1 Flood Hazard Reevaluation Report." October 21, 2015, ADAMS Accession No. ML15294A530.

SNC, 2015b, Joseph.M. Farley, Units 1 and 2 - Request For Additional Information Recommendation 2.1 Flood Hazard Reevaluation Report, November 02, 2015, ADAMS Accession No. ML15306A516.

USACE (U.S. Army Corps of Engineers), 1990, "Maximum Periodic Wave Runup on Smooth Slopes," Miscellaneous Paper CERC-90-4, 1990.

USACE, 1997, "Hydrologic Engineering Requirements for Reservoirs," Engineer Manual EM 1110-2-1420, 1997.

USACE, 2008, "Coastal Engineering Manual," Engineer Manual 1110-2-1100, available online at http://www.publications.usace.army.mil/USACEPublications/EngineerManuals.

USACE, 2010a, "River Analysis System (HEC-RAS), Version 4.1.0," (computer program), Hydrologic Engineering Center, U.S. Army Corps of Engineers, January 2010. Program and documentation available online from http://www.hec.usace.army.mil/software/hec-ras/.

USACE, 2010b, "Hydrologic Modeling System (HEC-HMS), Version 3.5.0," (computer program), Hydrologic Engineering Center, U.S. Army Corps of Engineers, August 2010. Program and documentation available online from http://www.hec.usace.army.mil/software/hec-hms/.

USACE, 2015, "Evaluation of Chattahoochee River Basin Dams and Potential Flood Hydrographs at Farley Nuclear Power Plant," June 2015, ADAMS Accession No. ML15176A604 (Non-public).

USACE, n.d.-a, "Ice Jam Database," (Web site) U.S. Army Corps of Engineers, Cold Region Research and Engineering Laboratory (CRREL), http://icejams.crrel.usace.army.mil/.

**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<br>SRP 2.4.3 |
| Streams and Rivers | SRP 2.4.2<br>SRP 2.4.3 |
| Failure of Dams and Onsite Water Control/Storage Structures | SRP 2.4.4<br>JLD-ISG-2013-01 |
| Storm Surge | SRP 2.4.5<br>JLD-ISG-2012-06 |
| Seiche | SRP 2.4.5<br>JLD-ISG-2012-06 |
| Tsunami | SRP 2.4.6<br>JLD-ISG-2012-06 |
| Ice-Induced | SRP 2.4.7 |
| Channel Migrations or Diversions | SRP 2.4.9 |

SRP is the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition (NRC, 2007)

JLD-ISG-2012-06 is the "Guidance for Performing a Tsunami, Surge, or Seiche Hazard Assessment" (NRC, 2013a)

JLD-ISG-2013-01 is the "Guidance for Assessment of Flooding Hazards Due to Dam Failure" (NRC, 2013b)

**Table 3.0-1. Summary of Controlling Flood-Causing Mechanisms**

| Reevaluated Flood-Causing Mechanisms and Associated Effects that May Exceed the Power Block Elevation (154.5 ft (47.09 m) )[1] | Elevation, NGVD29 |
|---|---|
| Local Intense Precipitation and Associated Drainage | |
| Auxiliary Unit 1 | 155.8 ft (47.49 m) |
| Auxiliary Unit 2 | 155.8 ft (47.49 m) |
| Containment Unit 1 | 155.2 ft (47.30 m) |
| Containment Unit 2 | 156.0 ft (47.55 m) |
| Diesel Generator Building | 155.4 ft (47.37 m) |
| Service Water Intake Structure | 195.8 ft (59.68 m) |
| Failure of Dams and Onsite Water Control Structures | |
| Offsite Dam Failure | [redacted] |
| Combined Effects – Hydrologic Failure and Wave Runup | [redacted] |

[1] Flood height and associated effects are as defined in JLD-ISG-2012-05 (NRC, 2012d)

**Table 3.1-1. Current Design Basis Flood Hazards**

| Flooding Mechanism | Stillwater Elevation NGVD29 | Associated Effects | Current Design Basis Flood (CDB) Elevation NGVD29 | Reference |
|---|---|---|---|---|
| **Local Intense Precipitation**<br><br>Outside Turbine Building | 6.0 inch (15.24 cm) depth | Minimal | 6.0 inch (15.24 cm) depth | FHRR 3.b.1 and Table 5-1 |
| **Streams and Rivers**<br><br>Chattahoochee River | 144.2 ft (43.95 m) | 9.1 ft (2.77 m) | 153.3 ft (46.73 m) | FHRR Section 3.b.2, Section 3.b.8, and Table 5-1 |
| **Failure of Dams and Onsite Water Control Structures** | | | | |
| Offsite Dam Failure | [redacted] | [redacted] | [redacted] | FHRR Section 3.b.3 and Table 5.1 |
| Onsite Dam Failure | [redacted] | [redacted] | [redacted] | FHRR Section 3.b.4 |
| Combined Effects - Hydrologic Failure and Wave Runup | [redacted] | [redacted] | [redacted] | FHRR Section 3.b.8 |
| Seismic Failure Walter F. George Dam | [redacted] | [redacted] | [redacted] | FHRR Section 3.b.3 |
| Seismic Failure and Wave Run-up | [redacted] | [redacted] | [redacted] | FHRR Section 3.b.8 |
| **Storm Surge** | No Impact on the Site Identified | No Impact on the Site Identified | No Impact on the Site Identified | FHRR Section 3.b.5 and T7able 5.1 |

| Flooding Mechanism | Stillwater Elevation NGVD29 | Associated Effects | Current Design Basis Flood (CDB) Elevation NGVD29 | Reference |
|---|---|---|---|---|
| **Seiche** | No Impact on the Site Identified | No Impact on the Site Identified | No Impact on the Site Identified | FHRR Section 3.b.5 and Table 5-1 |
| **Tsunami** | No Impact on the Site Identified | No Impact on the Site Identified | No Impact on the Site Identified | FHRR Section 3.b.5 and Table 5-1 |
| **Ice Induced Flooding** | No Impact on the Site Identified | No Impact on the Site Identified | No Impact on the Site Identified | FHRR Section 3.b.6 and Table 5-1 |
| **Channel Migration / Diversion** | No Impact on the Site Identified | No Impact on the Site Identified | No Impact on the Site Identified | FHRR Section 3.b.7 and Table 5-1 |

**Table 4.1-1. Reevaluated Hazard Elevations for Flood-Causing Mechanisms Not Bounded by the CDB**

| Mechanism | Stillwater Elevation NGVD29 | Waves/Runup | Reevaluated Hazard Elevation NGVD29 | Reference |
|---|---|---|---|---|
| **Local Intense Precipitation** | | | | |
| Auxiliary Unit 1 | 155.8 ft (47.49 m) | Minimal | 155.8 ft (47.49 m) | FHRR Table 4-2 and 5-1 |
| Auxiliary Unit 2 | 155.8 ft (47.49 m) | Minimal | 155.8 ft (47.49 m) | FHRR Table 4-2 and 5-1 |
| Containment Unit 1 | 155.2 ft (47.30 m) | Minimal | 155.2 ft (47.30 m) | FHRR Table 4-2 and 5-1 |
| Containment Unit 2 | 156.0 ft (47.55 m) | Minimal | 156.0 ft (47.55 m) | FHRR Table 4-2 and 5-1 |
| Diesel Generator Building | 155.4 ft (47.37 m) | Minimal | 155.4 ft (47.37 m) | FHRR Table 4-2 and 5-1 |
| Service Water Intake Structure | 195.8 ft (59.68 m) | Minimal | 195.8 ft (59.68 m) | FHRR Table 4-2 and 5-1 |
| **Failure of Dams and Onsite Water Control Structures** | | | | |
| Offsite Dam Failure | [redacted] | [redacted] | [redacted] | FHRR Section 4.c and Table 5-1 |
| Combined Effects – Hydrologic Failure and Wave Runup | [redacted] | [redacted] | [redacted] | FHRR Section 4.i and Table 5-1 |

Note 1: Reevaluated hazard mechanisms bounded by the CDB (see Table 1) are not included in this table.

Note 2: Reported values are rounded to the nearest one-tenth of a foot.

**Table 4.2-1. Flood Event Duration Parameters for Flood-Causing Mechanisms Not Bounded by the Plant's CDB**

| Mechanism | Time Available for Preparation for Flood Event | Duration of Inundation of Site | Time for Water to Recede from Site |
|---|---|---|---|
| **Local Intense Precipitation** | 24 hour | Not Provided | Not Provided |
| **Failure of Dams and Onsite Water Control Structures** | Not Provided | Not Provided | Not Provided |

Note 1: Reevaluated hazard mechanisms bounded by the CDB (see Table 1) are not included in this table.

**Table 4.3-1. Associated Effects Parameters not Directly Associated with Total Water Height for Flood-Causing Mechanisms not Bounded by the CDB**

| | Flooding Mechanism | |
|---|---|---|
| **Associated Effects Factor** | **Local Intense Precipitation** | **Failure of Dams and Onsite Water Control Structures** |
| Hydrodynamic loading at plant grade | Not provided[1] | Not provided[1] |
| Debris loading at plant grade | Not provided | Not provided |
| Sediment loading at plant grade | Not provided | Not provided |
| Sediment deposition and erosion | Not provided | Not provided |
| Concurrent conditions, including adverse weather | Not provided | Not provided |
| Other pertinent factors (e.g., waterborne projectiles) | Not provided | Not provided |

[1] The staff will evaluate associated effects parameters as part of future additional assessments.

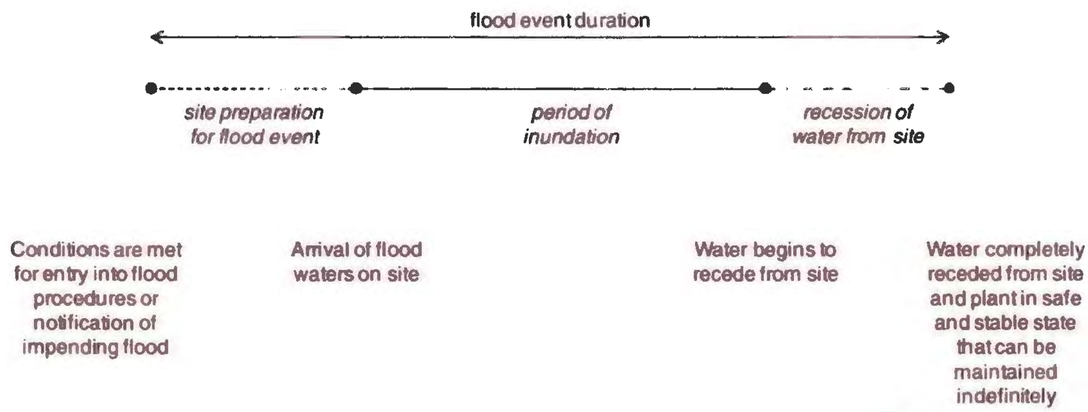


**Figure 2.2-1. Flood Event Duration (NRC, 2012c)**


Figure 3.1-1. Site Location Map for Farley. (Derived from SNC, 2015a).

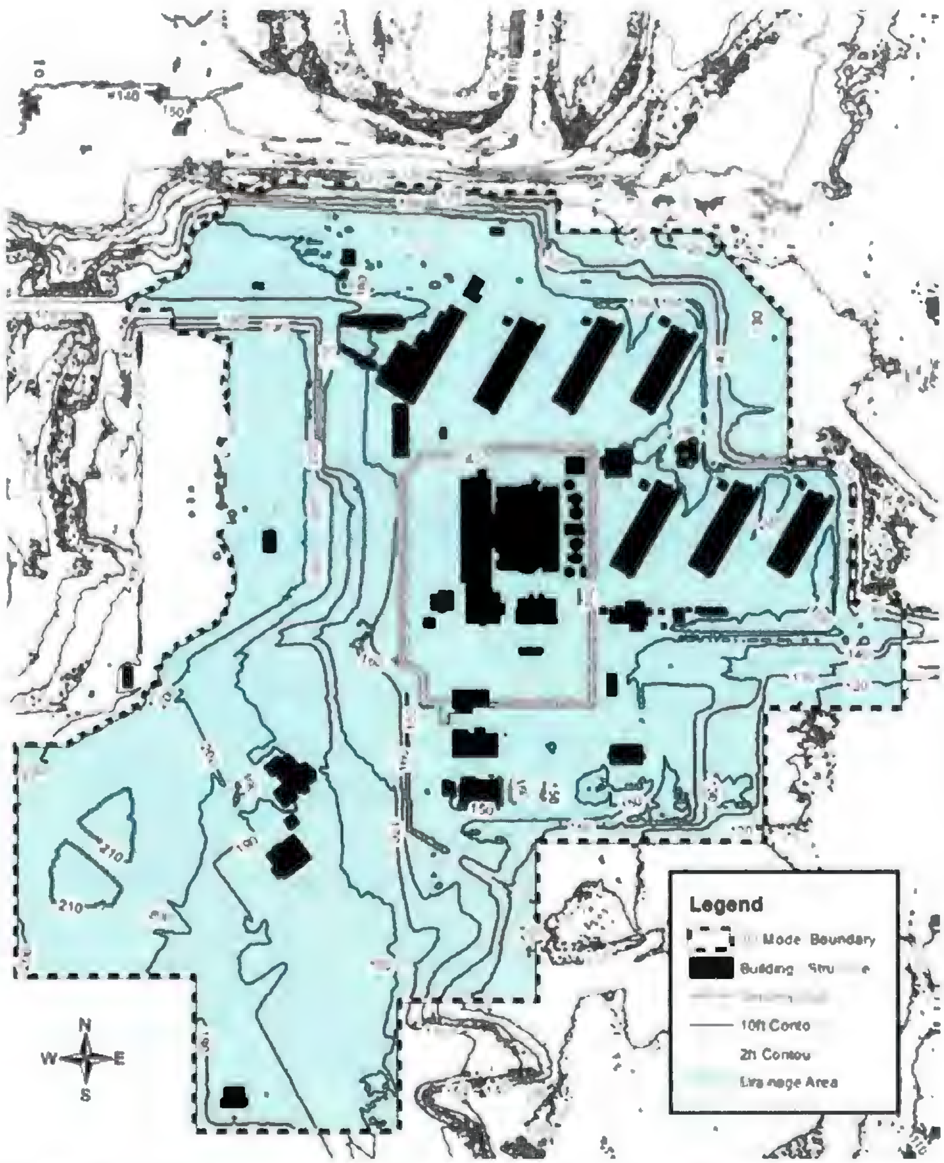


Figure 3.1-2 Topographic Map of Power Block Area (Elevations in NAVD88) (Derived from SNC, 2015b).

If you have any questions, please contact me at (301) 415-1056 or e-mail at Lauren.Gibson@nrc.gov.

Sincerely,

*/RA/*

Lauren Gibson, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear reactor Regulation

Docket Nos. 50-348 and 50-364

Enclosures:
1. Staff Assessment of Flood Hazard Reevaluation Report (non-public, security-related information)
2. Staff Assessment of Flood Hazard Reevaluation Report (public)

cc w/encl: Distribution via Listserv

<u>DISTRIBUTION</u>:

| | | |
|---|---|---|
| PUBLIC (Letter) | JLD R/F | RidsNRRJLD Resource |
| LKGibson, NRR | MShams, NRR | MFranovich, NRR |
| GBowman, NRR | YCheng, NRO | RidsNrrPMHatch |
| RidsNrrDorllpl2-1Resource | RidsNrrDorl Resource | Resource RidsRgn2MailCenter |
| RidsOpaMail Resource | RidsNrrLASLent | RidsOgcMailCenter Resource |
| ACampbell,NRO | SBreithaupt, NRO | MBensi, NRO |
| MMcBride, NRO | RidsNroDsea Resource | RidsNrrJLD Resource |
| KSee, NRO | CCook, NRO | RidsAcrsAcnw_MailCtr Resource |
| ARivera-Varona, NRO | | |

**ADAMS Accession Nos.:Package** ~~ML16288A150~~
**Letter w/redacted enclosure (public)** ML16288a167
**Letter w/ enclosure (non-public) –** ML16288A143 ***by input dated**

| | | | |
|---|---|---|---|
| **OFFICE** | NRR/JLD/JHMB/PM | NRR/JLD/LA | NRO/DSEA/RHM2/BC |
| **NAME** | LKGibson | SLent | ARivera-Varona* |
| **DATE** | 10/25/2016 | 10/21/2016 | 09/22/2016 |
| **OFFICE** | NRR/JLD/JHMB/BC(A) | NRR/JLD/JHMB/PM | |
| **NAME** | GBowman | LKGibson | |
| **DATE** | 11/03/2016 | 11/04/2016 | |

**OFFICIAL RECORD COPY**