Exelon Generation

RS-17-003 10 CFR 50.54(f)

January 5, 2017

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Renewed Facility Operating License Nos. DPR-53 and DPR-69
NRC Docket Nos. 50-317 and 50-318

Subject: Exelon Generation Company, LLC Response to March 12, 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 3, Flooding Focused Evaluation Summary Submittal

References:

1. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident; dated March 12, 2012

2. Constellation Energy Nuclear Group, LLC Letter to USNRC, Response to March 12, 2012 Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flooding Hazard Reevaluation Report, dated March 12, 2013

3. Constellation Energy Nuclear Group, LLC Letter to USNRC, Response to NRC 10 CFR 50.54(f) Request for Information Regarding Near-Term Task Force Recommendation 2.1, Flooding - Flooding Hazard Reevaluation, dated February 10, 2014

4. Exelon Generation Company, LLC Letter to USNRC, Response to March 12, 2012 Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flooding Hazard Reevaluation Report, dated September 23, 2015 (RS-15-247)

5. Exelon Generation Company, LLC Letter to USNRC, Response to March 12, 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flood Hazard Reevaluation Supplemental Information Regarding Associated Effects and Flood Event Duration Parameters, dated October 4, 2016 (RS-16-186)

6. NRC Letter, Supplemental Information Related to Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 1, 2013

7. NRC Staff Requirements Memoranda to COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards", dated March 30, 2015

8. NRC Letter, Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events, dated September 1, 2015

9. Nuclear Energy Institute (NEI) Report, NEI 16-05, Rev. 1, External Flooding Assessment Guidelines, dated June 2016

10. U.S. Nuclear Regulatory Commission, JLD-ISG-2016-01, Revision 0, Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation; Focused Evaluation and Integrated Assessment, dated July 11, 2016

11. NRC Letter, Calvert Cliffs Nuclear Power Plant, Units 1 and 2 – Supplement to Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (TAC Nos. MF3097 and MF3098), dated October 21, 2015

On March 12, 2012, the NRC issued Reference 1 to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for Flooding. One of the Required Responses in Reference 1 directed licensees to submit a Flood Hazard Reevaluation Report (FHRR). For Calvert Cliffs Nuclear Power Plant, Units 1 and 2, the FHRR was submitted on March 12, 2013 (Reference 2). Additional information for the March 2013 submittal was provided in Reference 3. The flooding analysis was revised to incorporate more detailed site-specific information and was submitted to the NRC on September 23, 2015 (Reference 4). Additional information for the September 2015 submittal was provided with Reference 5. Per Reference 6, the NRC considers the reevaluated flood hazard to be "beyond the current design/licensing basis of operating plants".

Following the Commission's directive to NRC Staff (Reference 7), the NRC issued a letter to industry (Reference 8) indicating that new guidance is being prepared to replace instructions (Reference 7), and provide for a "graded approach to flooding reevaluations" and "more focused evaluations of local intense precipitation and available physical margin in lieu of proceeding to an integrated assessment".

The Nuclear Energy Institute (NEI) prepared NEI 16-05, "External Flooding Assessment Guidelines" (Reference 9). The NRC endorsed NEI 16-05 (Reference 10) and recommended changes, which have been incorporated into NEI 16-05, Revision 1. NEI 16-05 indicates that each flood-causing mechanism not bounded by the Design Basis (DB) flood (using only stillwater and/or wind-wave runup levels) should follow one of the following five assessment paths:

- Path 1: Demonstrate Flood Mechanism is Bounded Through Improved Realism
- Path 2: Demonstrate Effective Flood Protection
- Path 3: Demonstrate a Feasible Response to LIP
- Path 4: Demonstrate Effective Mitigation
- Path 5: Scenario Based Approach

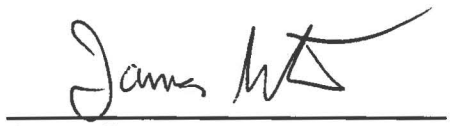
Non-bounded flood-causing mechanisms in Paths 1, 2, or 3 would only require a Focused Evaluation to complete the actions related to external flooding required by the March 12, 2012 10 CFR 50.54(f) letter. Mechanisms in Paths 4 or 5 require an Integrated Assessment.

The enclosure to this letter provides the Flooding Focused Evaluation Summary Report for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2. The original (March 2013) FHRR showed that two flooding mechanisms were not bounded by the plant's DB and were required to be evaluated in this FE; local intense precipitation (LIP) and storm surge. Both flooding mechanisms were revised (Reference 4) to more accurately characterize the floods with site-specific information. The revised reevaluation of the storm surge flood is bounded by the corresponding plant's DB flood. Therefore, the flood response strategy described in the USFAR remains valid for the storm surge flood and no further impact assessment was required. The revised reevaluated LIP flood is not bounded by the plant's DB, except at the Diesel Generator Building, since it was not analyzed in the power block area. However, the Focused Evaluation showed that plant grade and permanent passive protection provides effective protection against ingress from the revised reevaluated LIP flood. This submittal completes the actions related to external flooding required by the March 12, 2012 10 CFR 50.54(f) letter. Commitments made in Reference 2 are no longer required and are being discontinued based upon the results of this Focused Scope Assessment submittal.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Ron Gaston at (630) 657-3359.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 5th day of January 2017.

Respectfully submitted,



James Barstow
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure: Calvert Cliffs Nuclear Power Plant, Units 1 and 2, Flooding Focused Evaluation Summary, dated January 5, 2017

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region I
NRC Senior Resident Inspector – Calvert Cliffs Nuclear Power Plant
NRC Project Manager, NRR – Calvert Cliffs Nuclear Power Plant
Ms. Tekia Govan, NRR/JLD/JHMB, NRC
S. Gray, MD-DNR

Enclosure

Calvert Cliffs Nuclear Power Plant, Units 1 and 2

Flooding Focused Evaluation Summary

dated January 5, 2017

(19 Pages)

Exelon Generation®

CALVERT CLIFFS NUCLEAR POWER PLANT UNITS 1 & 2 FLOODING FOCUSED EVALUATION SUMMARY

JANUARY 5, 2017
LETTER # RS-17-003
ENCLOSURE #1

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CALVERT CLIFFS FLOODING FOCUSED EVALUATION SUMMARY

1 EXECUTIVE SUMMARY

The Calvert Cliffs Nuclear Power Plant has reevaluated its flooding hazard in accordance with the NRC's March 12, 2012, 10 CFR 50.54(f) request for information (RFI). The RFI was issued as part of implementing lessons learned from the Fukushima Dai-ichi accident; specifically, to address Recommendation 2.1 of the NRC's Near-Term Task Force report. This information was submitted to NRC in a flood hazard reevaluation report (FHRR) on March 12, 2013 and is provided in the Mitigating Strategies Flood Hazard Information (MSFHI) documented in NRC's "Supplement to Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation" letter dated October 21, 2015. The October 2015 NRC letter was based on the March 2013 flood hazard reevaluation submittal. The flooding analysis was revised to incorporate site-specific meteorological information and submitted to the NRC on September 23, 2015. The September 2015 flooding analysis, which was not included in the NRC's October 2015 Supplement to the Staff Assessment, will serve as the input to this Focused Evaluation (FE). There were 2 mechanism(s) that were found to exceed the design basis flood level in the March 2013 reevaluation. These mechanisms are listed below and included in this FE:

1. Local Intense Precipitation
2. Storm Surge

Associated effects (AE) and flood event duration (FED) parameters were assessed and submitted as a part of the flood hazard reevaluation and supplemental submittals, including responses to requests for additional information on February 10, 2014 and October 4, 2016. The FE concludes the revised reevaluation of the storm surge flood levels are bounded by the corresponding plant's design basis flood levels and permanent passive protection as well as plant grade provides protection against ingress from the LIP flood. This FE followed Paths 1 and 2 of NEI 16-05, Rev. 1, for Storm Surge and Local Intense Precipitation, respectively, and utilized Appendices A and B for guidance on evaluating the site strategy. This submittal completes the actions related to External Flooding required by the March 12, 2012 10 CFR 50.54(f) letter.

2 BACKGROUND

On March 12, 2012, the NRC issued Reference 1 to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for flooding. The RFI (Reference 1) directed licensees, in part, to submit a Flood Hazard Reevaluation Report (FHRR) to reevaluate the flood hazards for their sites using present-day methods and guidance used for early site permits and combined operating licenses. For Calvert Cliffs Nuclear Power Plant (CCNPP), Units 1 and 2, the FHRR was originally submitted on March 12, 2013 (Reference 2). Additional information was provided with Reference 3. Site specific meteorological information was developed and incorporated into an updated flood hazard reevaluation for Storm Surge and Local Intense Precipitation (LIP), which was submitted to the NRC on September 23, 2015 (Reference 4). Site specific responses to NRC Staff questions were provided in Reference 5 in October 2015. Per Reference 6, the NRC considers the reevaluated flood hazard to be "beyond the current design/licensing basis of operating plants".

Following the Commission's directive to NRC Staff in Reference 7, the NRC issued a letter to industry (Reference 8) indicating that new guidance is being prepared to provide for a "graded approach to flooding reevaluations" and "more focused evaluations of local intense precipitation and available physical margin in lieu of proceeding to an integrated assessment." NEI prepared the new "External Flooding Assessment Guidelines" in NEI 16-05 (Reference 9), which was endorsed by the NRC in Reference 10. NEI 16-05 indicates that each flood-causing mechanism not bounded by the design basis flood (using only stillwater and/or wind-wave runup level) should follow one of the following five assessment paths:

- Path 1: Demonstrate Flood Mechanism is Bounded Through Improved Realism
- Path 2: Demonstrate Effective Flood Protection
- Path 3: Demonstrate a Feasible Response to LIP
- Path 4: Demonstrate Effective Mitigation
- Path 5: Scenario Based Approach

Non-bounded flood-causing mechanisms in Paths 1, 2, or 3 would only require an FE to complete the actions related to external flooding required by the March 12, 2012 10 CFR 50.54(f) letter. Mechanisms in Paths 4 or 5 require an Integrated Assessment.

3 REFERENCES

1. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident; dated March 12, 2012.
2. Constellation Energy Letter to USNRC, Response to March 12, 2012 Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flooding Hazard Reevaluation Report, dated March 12, 2013.
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4. Exelon Generation Company, LLC Letter to USNRC, Response to March 12, 2012 Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flooding Hazard Reevaluation Report, dated September 23, 2015 (RS-15-247).
5. Exelon Generation Company, LLC Response to March 12, 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flood Hazard Reevaluation Supplemental Information Regarding Associated Effects and Flood Event Duration Parameters, dated October 4, 2016 (RS-16-186).
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7. NRC Staff Requirements Memoranda to COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards", dated March 30, 2015.
8. NRC Letter, Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events, dated September 1, 2015.
9. Nuclear Energy Institute (NEI), Report NEI 16-05 [Rev 1], External Flooding Assessment Guidelines, dated June 2016.
10. NRC JLD-ISG-2016-01, Guidance for Activities Related to Near-Term Task Force Recommendation; Focused Evaluation and Integrated Assessment, dated July 11, 2016.

11. NRC Letter, Calvert Cliffs Nuclear Power Plant, Units 1 and 2 – Supplement to Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (TAC NOS. MF3097 and MF3098).
12. Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America, NUREG/CR-7046, November 2011.
13. EPRI 3002008113, "Evaluation of Deterministic Approaches to Characterizing Flood Hazards", December 2016
14. CEC-008-CALC-03, Local Intense Precipitation Drainage Study for Calvert Cliffs Nuclear Power Plants Units 1 & 2, September 2015
15. 25794-000-K0C-0000-00001, Local PMP Drainage Study, December 2012
16. CEC-008-CALC-02, Site – Specific LIP PMP Evaluation for Calvert Cliffs Nuclear Power Plants Units 1 & 2, September 2015

4 TERMS AND DEFINITIONS

- AIMs – Assumptions, Inputs, and Methods
- APM – Available Physical Margin
- CCNPP – Calvert Cliffs Nuclear Power Plant
- CLB – Current Licensing Basis
- DB – Design Basis
- EDG – Emergency Diesel Generator
- ELAP – Extended Loss of ac Power
- FIAP – Flooding Integrated Assessment Process
- FHRR – Flood Hazard Reevaluation Report
- FLEX – Diverse and flexible coping strategies covered by NRC order EA-12-049
- Key SSC – A system Structure or Component relied upon to fulfill a Key Safety Function
- KSF – Key Safety function, i.e. core cooling, spent fuel pool cooling, or containment function.
- LIP – Local Intense Precipitation
- LUHS – Loss of Normal Access to the Ultimate Heat Sink
- MSA – Mitigating Strategies Assessment as described in NEI 12-06 Rev 2, App G
- MSFHI – Mitigating Strategies Flood Hazard Information
- NTTF – Near Term Task Force commissioned by the NRC to recommend actions following the Fukushima Dai-ichi accidents
- RFI – Request for Information
- SBO – Station Blackout
- TSA – Time Sensitive Action, as described in NEI 16-05 appendix C

5 FLOOD HAZARD PARAMETERS FOR UNBOUNDED MECHANISMS

NRC has completed the "Supplement to Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation" (Reference 11) which contains reevaluated flood hazard information related to CCNPP's Flood Hazard Reevaluation Report (References 2 and 3). In Reference 11, the NRC states that the "staff has concluded that the licensee's reevaluated flood hazards information is suitable for the assessment of mitigation strategies developed in response to Order EA-12-049 (i.e., defines the mitigating strategies flood hazard information described in Nuclear Energy Institute (NEI) guidance documents currently being finalized by the industry and staff [NEI 12-06, Rev 2]) for Calvert Cliffs". Further, the NRC staff has concluded that the "licensee's reevaluated flood hazard information is suitable input for other assessments [Focused Evaluations or Integrated Assessments] associated with Near-Term Task Force Recommendation 2.1 'Flooding'." In Table 3.1-2 of Reference 11, the NRC addresses the following flood-causing mechanisms for the design basis flood:

- Local Intense Precipitation;
- Streams and Rivers;
- Failure of Dams and Onsite Water Control/Storage Structures;
- Storm Surge;
- Seiche;
- Tsunami;
- Ice Induced Flooding; and
- Channel Migrations/Diversions.

Tables 4.0-1 through 4.0-3 contain the reevaluated flood hazard parameters (flood level, flood event duration, and associated effects) for the following flood-causing mechanisms that are not bounded by the design basis hazard flood level:

- Local Intense Precipitation
- Storm Surge

It should be noted that the "storm surge" flood-causing mechanism for CCNPP represents the NUREG/CR-7046 (Reference 12), Section H, 3.2, Combined-Effects Flood (Floods along Shores of Open and Semi-Enclosed Bodies of Water (Shore Location)). These are the reevaluated flood-causing mechanisms that should be addressed in the external flooding assessment. The two non-bounding flood mechanisms for CCNPP are described in detail in References 2 and 3, the original FHRR submittals. The following summarizes how each of these unbounded mechanisms was addressed in this external flooding assessment:

Table 1 – Summary of Flood Impact Assessment

	Flood Mechanism	Summary of Assessment
1	Storm Surge	This mechanism will follow FIAP Path 1, as described in Table 6.3 of NEI 16-05. Parameters were revised for the FIAP.
2	Local Intense Precipitation	This mechanism will follow FIAP Path 2, as described in Table 6.3 of NEI 16-05, based on the reevaluated flood levels addressed solely by passive, permanent protection features, and APM can be demonstrated to be adequate to protect Key SSCs and maintain KSF's. Parameters were revised for the FIAP.

5.1 Revised Storm Surge

This section contains a description and justification of assumption, input, and methods (AIMs) that were revised in the updated flood hazard reevaluation submitted on September 23, 2015 (Reference 4), with additional information provided in Reference 5. See Reference 4 for more details on the revised approach.

Table 2 – Discussion of Revised Assumptions, Inputs, and Methods (AIMs) for Storm Surge

	Description of Revised AIM	Justification of Reduced Conservatism
1	The original FHRR is based on Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model used by the National Hurricane Center for storm surge prediction. The reevaluated PMSS analysis utilizes a more accurate Delft3D modeling approach.	The original storm surge analysis used a SLOSH model, which is a depth-averaged two-dimensional finite difference model on curvilinear polar, elliptical, or hyperbolic grid schemes. Some of the limitation of the SLOSH program are: 1) SLOSH utilizes a simplified parametric wind model, based on pressure and radius of maximum winds to calculate the wind stresses over water that generate storm surge values for the model. 2) Grid resolution and bathymetry used in SLOSH are coarse. 3) The SLOSH model results are within 20% and do not consider river flow, rainfall, wind-wave interaction and wave setup. 4) Topographic inundation is performed utilizing low resolution topography data. The revised method uses Delft3D, a two-dimensional surge model capable of more accurately modeling hurricane wind and pressure fields over complex bathymetry and topography. The model was calibrated to past hurricane storms (addressing the 20% potential error) and used to simulate the effects of flow movement (surge) and wave propagation (wave spectra, height, period, and setup) through a water body (Atlantic Ocean and Chesapeake Bay) when acted upon by external forcing functions (wind fields, atmospheric pressure fields, and tides).

The revised parameters for storm surge are provided in the table below. Since storm surge is addressed using Path 1, only stillwater and wind-wave runup levels are

provided. Information for Table 3 was obtained from Table 3.0-4 in the enclosure to Reference 4 (rounded to the nearest tenth of a foot).

Table 3 – Flood Mechanism Parameters for the Revised Storm Surge Flood

Flood Mechanism Parameters		
	Parameter Description	**Values/Discussion**
1	Max Stillwater Elevation	15.5 feet NGVD-29
2	Max Wave Run-up Elevation	26.8 feet NGVD-29

5.2 Revised Local Intense Precipitation

This section contains a description and justification of assumption, input, and methods (AIMs) that were revised in the updated flood hazard reevaluation submitted on September 23, 2015 (Reference 4), with additional information provided in Reference 5. See Reference 4 for more details on the revised approach.

Table 4 – Discussion of Revised Assumptions, Inputs, and Methods (AIMs) for Local Intense Precipitation

	Description of Revised AIM	**Justification of Reduced Conservatism**
1	The original FHRR was based on generalized probable maximum precipitation (PMP) estimates obtained from the NOAA Hydrometeorological Reports (HMR) 51 and 52. The 1-hour, 1-mi^2 PMP, obtained from HMRs 51 and 52, was 18.5 inches. The revised FHRR is based on a site-specific meteorological PMP study, which produced a more accurate 1-hour, 1-mi^2 rainfall depth of 11.7 inches.	HMRs 51 and 52 provide generalized PMP values over large geographic areas without considering specific watershed characteristics. The site-specific meteorological study provides a more accurate representation of the PMP by considering local and regional orographic effects of topography, refined and updated observed PMP-type storms, transposition limits, and maximization factors. Further justification for using site-specific meteorological information is provided in EPRI 3002008113 Report, Section 3.1.a (Reference 13). No actions or changes are needed by the site to validate the revised input.

The revised parameters for LIP are provided in the table below. Since the revised LIP parameters are used for the impact assessment in Section 7, associated effects and duration parameters, as applicable, are provided. Information for Table 5 was obtained from Table 3.0-3 in the enclosure to Reference 4 (rounded to the nearest tenth of a foot).

Table 5 – Flood Mechanism Parameters for the Revised LIP Flood

	Parameter Description	Values/Discussion
1	Max Stillwater Elevation	43.6 to 44.9 feet MSL. The reevaluated flood elevation is bounded by the current design basis at the EDG and SBO buildings. UFSAR does not provide LIP water surface elevation at other critical structures. The reevaluation water surface elevation at other critical structures is below finish floor elevation of 45.0 feet MSL.
2	Max Wave Run-up Elevation	Consideration of wind-wave action for the LIP event is not explicitly required by NUREG/CR-7046 and is judged to be a negligible associated effect because of limited fetch lengths and flow depths.
3	Max Hydrodynamic/Debris Loading	The hydrodynamic and hydrostatic loads are bounded by the design basis maximum tornado wind load. The debris load for the LIP event is assumed to be negligible due to the absence of heavy objects at the plant site and due to low flow velocity, the factors combination of which could lead to a hazard due to debris load.
4	Effects of Sediment Deposition/Erosion	The flow velocities due to the LIP event are determined to be below the suggested velocities for the ground cover type (concrete and gravel) at the plant area. Therefore, the erosion is not considered to be a significant effect during the LIP flood.
5	Other Associated Effects	No other significant detrimental effects associated with the LIP flood were identified
6	Concurrent Site Conditions	High winds could be generated concurrent to a LIP event. However, manual actions are not required to protect the plant from LIP flooding so this concurrent condition is not applicable.
7	Effects on Ground Water	The majority of the plant area is paved or gravel and results in minimal infiltration, if any. Therefore, it is expected that infiltration of precipitation and groundwater seepage would likely be minimal. Additionally, the event is a short-duration (1-hour precipitation) which limits the amount of soil Infiltration.

	Parameter Description	Values/Discussion
8	Warning Time	Key SSCs are currently protected by means of permanent/passive measures. Therefore, flood event duration parameters are not applicable to the LIP flood.
9	Period of Site Preparation	
10	Period of Inundation	
11	Period of Recession	
12	Plant Mode of Operation	Any
13	Other Factors	There are no other factors, including waterborne projectiles, applicable to the LIP flood.

6 OVERALL SITE FLOODING RESPONSE

6.1 DESCRIPTION OF OVERALL SITE FLOODING RESPONSE

For the storm surge flood-causing mechanism, this FE demonstrates that no doors, buildings, or propagation pathways that contain Key SSC's are challenged by flood waters during the PMSS event at CCNPP. The revised reevaluated flood (Reference 4) levels are bounded by the current design basis levels. Therefore, current actions required by the UFSAR addresses the flooding response for the reevaluated storm surge flood and no Key SSC's would be affected during the PMSS event.

For the LIP flood-causing mechanism, site topographic characteristics and plant structures, are modeled in LIP Drainage Study Calculation CEC-008-CALC-003 (Reference 14), which determined the flooding effects at CCNPP Units 1 & 2 during a LIP event. The maximum water levels are compared to the door and penetration elevations of the critical structures and flooding durations are estimated. This calculation is based on hydrologic (HEC-HMS) and hydraulic (HEC-RAS) models obtained from Local PMP Drainage Study Calculation 25794-000-KOC-0000-00001 (Reference 15) and site-specific LIP PMP evaluation from Calculation CEC-008-CALC-02 (Reference 16).

Critical structures at CCNPP Units 1 & 2 that house Key SSC's consist of the Emergency Diesel Generator (EDG) buildings, utility buildings, and the reactor complex which consists of the turbine building, the auxiliary building, two maintenance & service buildings, and two reactors. See Tables 6 and 10 below for elevation of the entrances and the floor of the safety-related facilities which range from 45 to 45.5 feet MSL. The ground and entrance elevations for safety-related structures, the associated HEC-RAS cross sections, peak water levels, maximum water depth, channel velocity, and freeboard above entrance floor elevation are summarized in Table 10.

Table 6 - Auxiliary Building West Road Door Elevation & Description

Door #	Room Description	Elevation (ft MSL) - Location
415	2B Emergency Diesel Room	45 - West Road
416	Truck Access to West Loading Area	45 - West Road
417	Truck Access to Cask/ Railcar Pit	45 - West Road
418	West loading SW Area Access	45 - West Road
419	45 feet MSL Auxiliary Building	45 - West Road
421	1B Emergency Diesel Room	45 - West Road
422	2B Emergency Diesel Room	45 - West Road
446	U1 Refueling Water Tank Pump Room	45 - West Road
447	U2 Refueling Water Tank Pump Room	45 - West Road

The revised FHRR contains the HEC-RAS model results and indicates that the peak flood levels in the power block will remain below floor elevations, resulting in no Key SSCs or equipment being affected by water ingress during the LIP Event.

6.2 Modifications and Changes

None required.

7 FLOOD IMPACT ASSESSMENT

7.1 STORM SURGE

7.1.1 Comparison of New Flood Levels to the Design Basis

A comparison of the revised flood levels to the design basis flood for storm surge is provided in the table below. Information for Table 7 was obtained from Table 3.0-4 in the enclosure to Reference 4 (rounded to the nearest tenth of a foot). Since the revised storm surge flood levels are bounded by the corresponding design basis flood levels, the FIAP being followed for storm surge is Path 1 and no further impact assessment is required.

Table 7 – Design Basis vs Revised FHRR Storm Surge Flood Level Comparison

	Parameter Description	Design Basis or Licensing Basis Flood Levels	Revised FHRR Levels (Reference 4)	Bounded (B) or Not Bounded (NB)
1	Max Stillwater Elevation	16.2 feet NGVD-29	15.5 feet NGVD-29	B
2	Max Wave+ Run-up Elevation	28.1 feet NGVD-29	26.8 feet NGVD-29	B

Table 8 – Storm Surge Summary Comparison

Parameter Description	Plant Design or Licensing Basis Flood Levels	FHRR Levels (Reference 2)	Revised FHRR Levels (Reference 4)
Max Wave+ Run-up Elevation	28.1 feet NGVD -29	31.3 feet NGVD -29	26.8 feet NGVD -29

7.2 Local Intense Precipitation

7.2.1 Description of Flood Impact

For LIP, the revised maximum reevaluated flood elevation is lower than the design basis LIP flood level at the 1A EDG Building. However, critical structures (Auxiliary Building, Turbine Building & South Service Building) were not analyzed for LIP in the plant's design basis. Permanent passive protection features, such as site topographic characteristics and plant structures, are relied on for protection against a LIP event. Per the results contained in the revised FHRR (Reference 4), no Key SSC's are challenged during the flood event due to a LIP event, as the flood elevations do not reach the 45-foot MSL Power Block grade elevations.

Tables 9 & 10 and Figures 1 & 2 below depict the elevation of power block structures and LIP water levels. The results of the review indicated that these structures are protected from LIP flood ingress by plant grade up to elevation 45.0 feet MSL. Conservatively, the worst case APM or freeboard is +0.14 foot; therefore, consequential flooding concerns are not applicable.

Table 9 – Comparison of LIP Results

Parameter	CLB	FHRR	Revised FHRR
LIP (ft.- MSL)	44.81	45.1 - 47	43.64 - 44.86

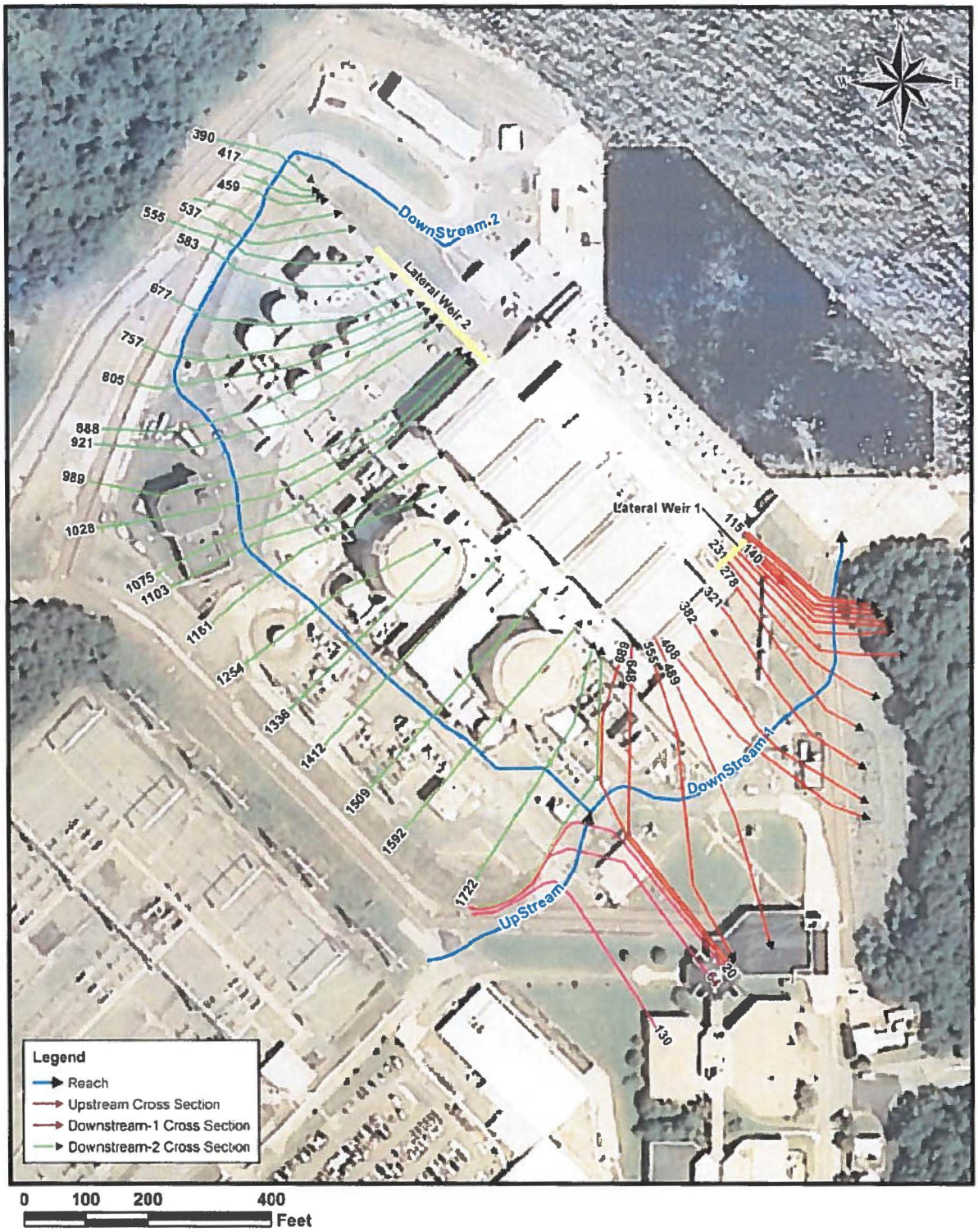
[1]CLB value is for the 1A EDG Building only; UFSAR does not identify LIP CLB for other buildings.

Table 10 – Comparison of Maximum Water Level & Floor Elevation at Openings/ Entrances of Critical Structures

Critical Structures	[JB1]Entrance Floor Elev. (ft)	HEC-RAS Cross Section	Reach	Min Channel Elevation (ft)	Peak Water Surface Elevation (ft)	Max Water Depth (ft) = Col B-Col A	Channel Velocity (ft/s)	Freeboard Above Entrance Floor Elevation (ft)	Duration of Flooding at Entrances (ft)
				A	B				
South Service Building	45	489	Downstream-1	43.7	44.86	1.16	1.36	0.14	N/A
Turbine Building	45	382	Downstream-1	43.7	44.65	0.95	2.15	0.35	N/A
Auxiliary Building	45	1722	Downstream-2	43.35	44.86	1.51	0.61	0.14	N/A
Auxiliary Building	45	1509	Downstream-2	43.5	44.81	1.31	1.18	0.19	N/A
Auxiliary Building	45	1412	Downstream-2	43.15	44.79	1.64	0.71	0.21	N/A
Auxiliary Building	45	1336	Downstream-2	43.5	44.76	1.26	1.32	0.24	N/A
Turbine Building	45	1075	Downstream-2	43	44.64	0.64	5.39	1.36	N/A
Diesel Generator Building	45.5	1075	Downstream-2	43	43.64	0.64	5.39	1.86	N/A

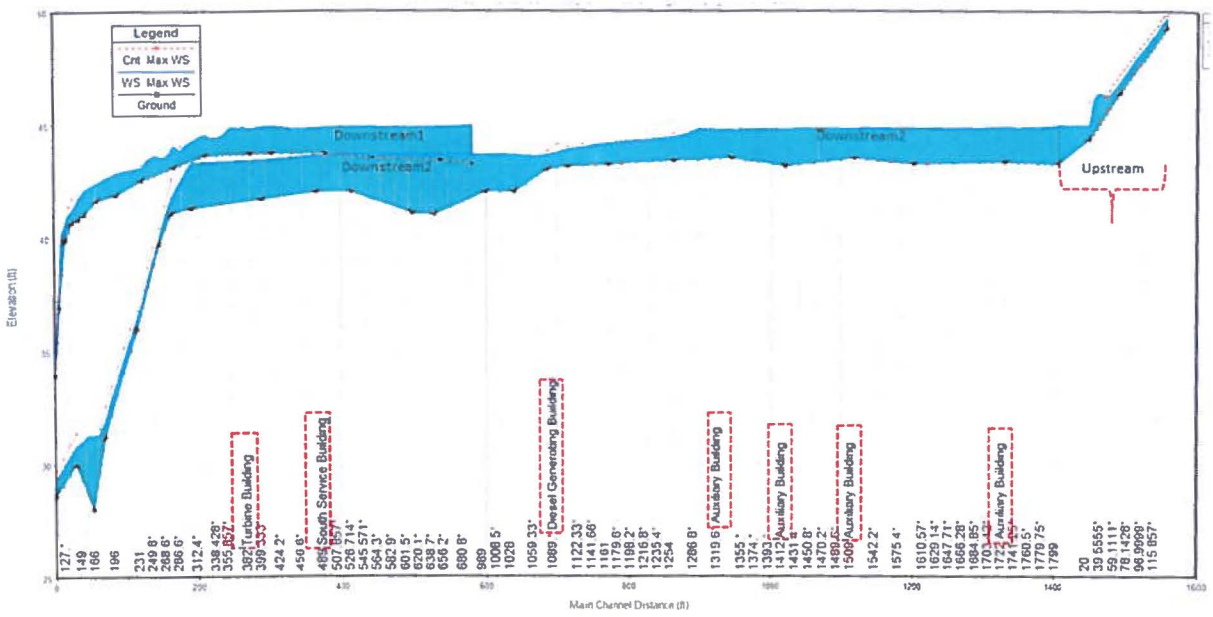
[Table 8.1 from CEC-0008-CALC-03, Reference 14]

Figure 1 – HEC-RAS Model Cross Section Plan



[Figure 2.1-7a from CCNPP FHRR, Reference 2]

Figure 2 – Local PMP Maximum Water Level Profiles



[Figure 2.1-9 from Amendment 1 CCNPP FHRR, Reference 4]

7.2.2 Adequate APM Justification and Reliability Flood Protection

CCNPP's uses a permanent/passive feature, specifically plant grade with a minimum protection level of 45.0 feet MSL, to reliably protect the plant from LIP ingress. The minimum 0.14-foot APM for LIP was determined to be adequate with the following justifications:

- The site drainage system is assumed to be nonfunctional at the time of the LIP event.
- No ground infiltration was considered. The entire model area was assumed to be impervious to maximize the runoff.
- Door openings for structures containing Key SSCs include a 6-inch curb to provide additional margin. The curb is not included in the APM value discussed above.

The elevation level-only is adequate in characterizing APM. APM for other associated effects and flood event duration parameters are not relevant for the same reasons discussed in Table 5.

7.2.3 Adequate Overall Site Response

Not applicable since no manual actions required for LIP.

8 CONCLUSION

Calvert Cliffs Nuclear Power Plant, Units 1 & 2 original FHRR (References 2 & 3) showed that two flooding mechanisms were not bounded by the CLB and were required to be evaluated in this FE.

The revised reevaluation (Reference 4) of the storm surge flood levels (stillwater and wind-wave runup) are bounded by the corresponding plant's design basis flood levels. Therefore, the flood response strategy described in the USFAR remains valid for the storm surge flood and no further impact assessment was required.

The revised reevaluated LIP flood is not bounded by the plant's design basis, except at the DGB Building, since it was not analyzed in the power block area. Plant grade provides protection against ingress from the revised reevaluated LIP flood. The FIAP, specifically a Path 2 Focused Evaluation, concluded that the LIP flood would not impact Key SSCs or KSFs with adequate margin.

This submittal completes the actions related to External Flooding required by the March 12, 2012 10 CFR 50.54(f) letter.