NRR-PMDAPEm Resource

From: Uribe, Juan
Sent: Monday, May 04, 2015 10:22 AM
To: Giddens, John M. (JMGIDDEN@southernco.com)
Cc: Shams, Mohamed; Kuntz, Robert; Martin, Robert
Subject: Hatch Nuclear Plant-Fukushima 2.1 Flooding-FHRR Review RAIs
Attachments: Hatch_RAIs-final.docx

Mr. Giddens,

By letter dated March 6, 2014, Southern Nuclear Operating Company, Inc. provided the Flood Hazard Reevaluation Report (FHRR) (Agencywide Documents Access and Management System (ADAMS) Accession Number ML14069A054) for the Edwin I. Hatch Nuclear Plant, Units 1 and 2, in response to Enclosure 2 of the 50.54(f) letter. During its review, the NRC staff determined that additional information was necessary to complete its assessment of the licensee's FHRR. The attachment in this email contains the NRC staff's Request for Additional Information (RAI). As previously discussed, the NRC staff requests a response within **30** days of this email.

Should you have any questions or comments, please do not hesitate to contact me.

Thanks

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Request for Additional Information related to the
Fukushima Lessons Learned Flood Hazard Reevaluation Report for the
Edwin I. Hatch Nuclear Plant - Units 1 and 2
(TAC Nos. MF3869 and MF3870)

By letter dated March 6, 2014, Southern Nuclear Operating Company, Inc. (SNC or the licensee) provided their Flood Hazard Reevaluation Report (FHRR) (Agencywide Documents Access and Management System (ADAMS) Accession Number ML14069A054) for the Edwin I. Hatch Nuclear Plant (Hatch or HNP), Units 1 and 2, in response to Enclosure 2 of the 50.54(f) letter. During its review, the NRC staff determined that additional information was necessary to complete its assessment of the licensee's FHRR. The following Request for Additional Information (RAI) letter documents the NRC staff's request.

RAI 1: Local Intense Precipitation and Associated Site Drainage

Calculation No SCNH-13-021 (SNC, 2013b) stated that the vehicle barrier system (VBS) is represented in the FLO-2D model as a levee feature located 3.5 ft. above ground elevation, with flow across the structure based on the broad crested weir equation. During the review, the NRC staff noted that the document does not describe how the openings within the VBS are represented in the model or whether any sensitivity analysis was conducted to determine their impact on the reevaluated flood level. The FHRR does not provide any justification (e.g., the function of the VBS as a flood protection structure) in lieu of a sensitivity analysis.

Provide:

a) Additional description and documentation on how the openings in the VBS are modeled and whether the VBS serves as a credited flood protection feature. Such documentation may include, but is not limited to model input parameters and assumptions related to the VBS.
b) Information on the sensitivity analysis that was performed to ensure the appropriateness of the selected levee feature to demonstrate acceptable level of conservatism. If no sensitivity analysis was performed, the response should include a discussion on how the peak flooding at the site may be impacted by excluding the levee feature and other appropriate assumptions and approaches of conservatism such as alternative LIP event durations and temporal distributions or improved representation of runoff from buildings as described in RAIs 2 and 4, respectively.

RAI 2: Local Intense Precipitation and Associated Site Drainage

The LIP evaluation presented in the calculation package SCNH-13-021 (SNC, 2013b) and the FHRR report does not precisely describe how precipitation onto building roofs was modeled. Staff's evaluation of the licensee's FLO-2D input files indicates that areas representing buildings are of significantly higher elevation than the surrounding area. Although the approach is technically acceptable, specific information on the methodology for considering the potential for localized flooding from roof runoff was not provided.

Provide a description and technical rationale of how rainfall onto buildings is routed at the site and whether the FLO-2D model accurately and conservatively captures impacts from flooding due to localized roof runoff to the ground. The analysis should also address other more conservative assumptions that may be warranted, such as alternative LIP event durations and temporal distributions as addressed in RAI 2 or improved representation of vehicle barrier system openings as addressed in RAI 3.

RAI 3: Combined Effect Flood Five-Day Dry Period

Attachment 1 of Enclosure 2 of the 10 CFR 50.54(f) lists Combined Effect Floods as a flood causing mechanism that should be addressed in the FHRR and provides additional information on the request. During the review, the NRC staff noted that the three combined effect flood hazard scenarios included a five-day dry period between the antecedent precipitation event and the full PMP event. The FHRR states that this dry period was included to account for the long lag time in the watershed; however, supporting data and detailed justification are not provided.

Provide additional information regarding how it was determined that a five-day dry period was appropriate, including a discussion of why this approach is conservative. As a part of the response, provide details on any sensitivity analysis that was conducted to evaluate the conservativeness of using this prolonged dry period.

RAI 4: Failure of Dams and Onsite Water Control/Storage Structures

Attachment 1 of Enclosure 2 of the 10 CFR 50.54(f) lists Dam Failures as a flood causing mechanism that should be addressed in the FHRR and provides additional information on the request. During the review, the NRC staff noted that the Lloyd Shoals, Lake Juliette (Plant Scherer), Wallace, and Sinclair dams were evaluated and determined to remain stable under individual PMF overtopping conditions while meeting FERC stability requirements. Staff reviewed information provided in the FHRR and documents provided in the electronic reading room for the dam breach analysis. The FHRR and Calculation Package No SCNH-13-019 indicate that seven critical dams were analyzed in addition to the hypothetical dams. The analysis performed is described as follows:

- For critical dams owned by Georgia Power Company (i.e., Sinclair, Wallace, Lake Juliette, and Lloyd Shoals), the dam failure calculation package did not provide technical justification on the type of stability analysis performed to declare the dams as stable, although one dam (Lloyd Shoals) was overtopped under PMF conditions. In addition, the range of PMFs (i.e., individual dam PMF vs. Plant Hatch watershed PMF) considered for stability analysis was not clear.
- For critical dams not owned by Georgia Power Company (i.e., Lake Tobesofkee, Town Creek Reservoir, and Upper Towaliga), the Froehlich and Xu and Zhang[1] dam breach methodologies were compared by the licensee; however, alternative methodologies were not evaluated. Though the licensee states that the methodologies were compared

[1]Xu, Y. and L.M. Zhang, 2009.Breaching parameters for earth and rockfill dams. Journal of Geotechnical and Geoenvironmental Engineering, 135(12):1957-1970.

to ensure conservatism, there is no documentation in the calculation package that describes the method that was finally used.
- For the hypothetical dams, the Xu Zhang dam breach parameters estimation methodology was used by the licensee; however, alternative methodologies were not evaluated.

It is also stated in the FHRR that the Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) software was used to model the sunny day, seismic, and overtopping dam breaches.The staff's initial review of the Xu and Zhang breach methodology resulted in the following observations:

- The methodology has not been applied in past hazard assessments related to the siting of new nuclear facilities by NRC staff.
- The methodology relies on highly subjective erodibility criteria with no clear ties to soil engineering and hydraulic properties, and moreover, the erodibility classes were inferred in many instances by indirect methods.
- The database used in the development of the equations by Xu and Zhang uses information from sites in China with minimal verifiability and assumptions about the prevailing conditions that are necessary to deduce information on erodibility.
- The methodology appears to have a different implementation of the dam breach time parameter as compared to other methodologies.
- The parameters used in Xu and Zhang to determine failure time do not appear to be suitable for use as the breach formation time parameter in the hydraulic model HEC-RAS, which is a widely used hydraulic flow modeling environment.

The U.S. Nuclear Regulatory Commission (NRC) has commissioned a study to determine the suitability of the Xu and Zhang methodology. The study was conducted by Mr. Tony Wahl, P.E., of the U.S. Bureau of Reclamation (USBR). He is the author of the 1998 report on breach parameter estimation[2] with over a decade of collaboration with developers modeling software such as WinDAM and HR-BREACH. The study was peer reviewed by some of the leading experts in this technical area. The details of the USBR study are published in the report "Evaluation of Erodibility-Based Embankment Dam Breach Equations" (Hydraulic Laboratory Report HL-2014-02 June, 2014)[3]. Based on the findings of the USBR study commissioned by the NRC and independent conclusions reached by FERC, the Xu and Zhang equations are not appropriate for standalone evaluation or comparison as applied in the submitted FHRR and should only be used to ensure a conservative approach is used.

In order to complete the staff's review, staff requests the following:

a) For critical dams not owned by Georgia Power Company (i.e., Lake Tobesofkee, Town Creek Reservoir, and Upper Towaliga), provide documentation describing how the

[2]Wahl, T.L., 1998. Prediction of embankment dam breach parameters: a literature review and needs assessment, Dam Safety Research Report DSO-98-004, U.S. Dept. of the Interior, Bureau of Reclamation, Denver, Colorado, July 1998.

[3]The report is published online at http://www.usbr.gov/pmts/hydraulics_lab/pubs/HL/HL-2014-02.pdf.

Froehlich and Xu and Zhang dam breach parameter estimation methodologies were compared to identify which method was more conservative. In addition, comparative results from other dam breach methodologies should be provided. The response should consider the potential for a domino-type failure or impacts of breach waves from upstream dams. Technical justification should be provided for the selection of the final breach model. Parameter uncertainty as well as parameter sensitivity in final model results should be explicitly addressed in the response.

b) For critical dams owned by Georgia Power Company (i.e., Sinclair, Wallace, Lake Juliette, and Lloyd Shoals), provide technical documentation explaining how it was determined that each dam would remain stable under conditions resulting from both the individual dam PMF and the Plant Hatch PMF. The justification should also provide a description of the dam breach parameters used, and as stated in part a) of this RAI, it should rely on methods other than Xu and Zhang. For Lloyd Shoals Dam in particular, justification should be provided to explain why the dam is assumed to not fail despite being overtopped.

c) For the hypothetical dams which were modeled using the Xu and Zhang methodology, staff requests use of alternative dam breach methodologies other than Xu and Zhang to compare the flooding impacts and ensure the most conservative method is applied as stated. Additionally describe why the addition of hypothetical dam simulation results in flow attenuation and reduced peak discharge.

RAI 5: Failure of Dams and Onsite Water Control/Storage Structures

The staff noted that the FHRR and the subsequent information provided by the licensee did not include all of the necessary documentation related to the hydrologic modeling of flooding from dam breach and multiple combined events scenarios which were mentioned in the calculation packages.

The licensee provided information by a letter dated August 6, 2014 (ML14219A570) in response to staff's request of June 23, 2014. The information provided included disks that contain computer input/output files for the following:

1. The HMR 52 computer program used for the local (LIP) and watershed (PMF) PMP calculations.
2. The FL0-2D model used for LIP surface runoff, routing, and flooding hazard analyses.
3. The HEC-HMS models used for surface flow modeling of the PMF and Combined Effects flooding hazards.
4. The HEC-RAS models used for routing and water elevation determination for the PMF and dam breach hazard analyses.
5. X-Y-Z Data files for topography and cross-section used for surface flow modeling including digitized maps and spatial modeling files used for processing elevation and delineation using GIS and CAD

Staff reviewed the HEC-HMS model files provided by the licensee and found that the HEC-HMS file contains a single model run, corresponding to Combined Events Scenario 1 only. The staff

also requires the dam failure model which corresponds to the peak flow (which is also the flow requiring clarification in RAI 7) reported in Calculation No SCNH-13-019 Section 8.3.3.3.

In addition, information related to the locations of dams and of the Plant Hatch Intake within the HEC-RAS model was not provided.

Provide the HEC-HMS input and output files used for evaluating hydrologic conditions under the various dam failure flooding scenarios and combined events scenarios considered. In addition, provide a description of the HEC-RAS river stations that correspond to upstream dam breach flows, and provide description of the river station used to evaluate flood water surface elevation at Plant Hatch.

RAI 6: Failure of Dams and Onsite Water Control/Storage Structures

Section 8.3.3.3 of Calculation No SCNH-13-019 (page 38), states that the critical dam breach scenario peak discharge is 913,030 cfs. However, in Section 5c of the FHRR (page 41), the peak flow rate for the overtopping dam breach scenario is a different and lower value (732,155 cfs). This different and lower peak flow rate is also reported in Calculation No SCNH-13-082, Table 8-2 and is associated with the reevaluated overtopping dam breach elevation reported in FHRR Table 13 (109.72 ft). This reevaluated overtopping dam breach elevation is used as the stillwater elevation to compute the effects of combined events. Based on review of the information provided, the peak discharge resulting from the critical dam breach scenario is not clear and moreover, it appears to be reported in an inconsistent manner.

Clarify why two peak discharge results are presented in the assessment of the dam breach scenarios. As a part of the response, discuss why the peak discharge value in Section 8.3.3.3 of Calculation No SCNH-13-019 and the associated water surface elevation are not clearly represented in the FHRR. A summary of the peak flow values associated with the flood hazard reevaluation elevations reported in FHRR Table 13 is also requested.

RAI 7: Hazard Input for the Integrated Assessment

a) LIP Durations and Intensities

Attachment 1 of Enclosure 2 of the 10 CFR 50.54(f) lists LIP as a flood causing mechanism that should be addressed in the FHRR and provides additional information on the request.

The FHRR identifies LIP flooding hazard as not bounded by the CDB and requiring an integrated assessment. Also, NRC interim staff guidance document JLD-ISG-2012-05, "Guidance for Performing an Integrated Assessment," November 2012 (ADAMS Accession No. ML12311A214) discusses flood event duration parameters,.During the review, the NRC staff noted that the LIP flood hazard reevaluation provided in the FHRR begins with the 1-hr, 1-mi^2 probable maximum precipitation (PMP) arranged in a front-loaded (or descending) distribution with the most intense rainfall occurring at the beginning of the event. This approach may not capture the potentially most conservative and bounding flood condition resulting from precipitation events of different magnitude, duration, and timing.

Provide justification for the selected LIP durations to demonstrate the selection is bounding in terms of warning time, flood depth, and flood duration. This justification needs to include sensitivity analysis of LIP event duration to consider localized (1 mi2) PMP events up to 72 hours in duration (e.g., 1-, 6-, 12-, 24-, 48-, 72-hour PMPs) and various rainfall distributions (e.g., center-weighted and others in addition to a front-loaded distribution). The evaluations need to identify potentially bounding scenarios with respect to flood height, event duration, and associated effects. These analyses should also address other more conservative assumptions that may be warranted, such as improved representation of the vehicle barrier system or runoff from buildings as addressed in RAIs 3 and 4, respectively. Provide electronic versions of the associated modeling input output files for the sensitivity runs.

b) Flood Event Duration Parameters

Enclosure 2 of the 50.54(f) letter requests the licensee to perform an integrated assessment of the plant's response to the reevaluated hazard if the reevaluated flood hazard is not bounded by the current design basis.

Provide the applicable flood event duration parameters (see definition and Figure 6 of the NRC interim staff guidance document JLD-ISG-2012-05, "Guidance for Performing an Integrated Assessment," November 2012 (ADAMS Accession No. ML12311A214), associated with mechanisms that trigger an integrated assessment using the results of the flood hazard reevaluation. These mechanisms are identified for Plant Hatch in FHRR Table 13; the site specific mechanisms are local intense precipitation, streams and rivers, dam failure, and combined effect scenarios. This includes (as applicable) the warning time the site will have to prepare for the event (e.g., the time between notification of an impending flood event and arrival of floodwaters on site) and the period of time the site is inundated for the mechanisms that are not bounded by the current design basis. Provide the basis or source of information for the flood event duration, which may include a description of relevant forecasting methods (e.g., products from local, regional, or national weather forecasting centers) and/or timing information derived from the hazard analysis.

RAI 8: Hazard Input for the Integrated Assessment

Enclosure 2 of the 50.54(f) letter requests the licensee to perform an integrated assessment of the plant's response to the reevaluated hazard if the flood hazard is not bounded by the current design basis. FHRR does not clearly describe associated effects of the selected flood scenarios that are proposed to be considered in the integrated assessment.

Provide the flood height and associated effects (as defined in Section 9 of JLD-ISG-2012-05) that are not described in the flood hazard reevaluation report for mechanisms that trigger an integrated assessment. For Plant Hatch, this includes the following quantified information for each flood causing mechanism which has been identified in the FHRR to have triggered Integrated Assessment as per the 50.54(f) letter. These include flooding from local intense precipitation, river and stream flooding, dam failure induced flooding, and combined effects scenarios. Flooding associated effects to be considered include (as applicable):

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

RAI 9: Comparison of Reevaluated Flood Hazard Pursuant to the Guidance in the 50.54(f) Letter

The request for information pursuant to Title 10 of the Code of Federal Regulations 50.54(f) dated March 12, 2012 provides guidance on the contents of the flood hazard reevaluation report. Table 13 of the FHRR for Plant Hatch provides a comparison of the reevaluated flood hazards with the current licensing basis (CLB) instead of the current design basis (CDB).

Staff also noted that for the intake structure (which contains a safety-related SSC), the pump centerline and finished floor elevation are different, as described in Section 4 a) (SSCs important to safety) and Section 7 (interim actions) of the FHRR. These differing elevations present some confusion when assessing the CDB for the intake structure.

Provide clarification for the inconsistencies identified in the FHRR with regard to the comparison of the reevaluated flood hazard to the current design bases and submit a revised hazard comparison consistent with the instructions provided in the 50.54(f) letter. Provide and update to FHRR Table 13 that references the Current Design Basis and its comparison to the reevaluated flood hazard; provide updated FHRR information that is consistent with the updated table.

Staff also requests clarification of the current design basis elevation of the safety-related SSCs contained within the intake structure. Section 4a and 7 in the FHRR seem to be specifying 2 different elevations for the safety related structure within the intake structure.