NRR-PMDAPEm Resource

From: Govan, Tekia
Sent: Monday, April 27, 2015 2:59 PM
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Subject: Request for Additional Information: River Bend Station - Flooding Hazard Reevaluation Report (TAC No. MF3675)
Attachments: RiverBendUnit1_FHRR_RAI.pdf

Docket Number 50-458

Mr. Williamson,

By letter dated March 12, 2014, Entergy Operations, Inc. (the licensee) submitted its flood hazard reevaluation report (FHRR) for River Bend Station, Unit 1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14073A648). Based upon the review of the River Bend Station, Unit 1 FHRR the NRC staff determined that the attached Requests for Additional Information (RAIs) are necessary to complete its assessment of the licensee's FHRR. The NRC requests that the licensee provide a response within 30 days of this e-mail.

The NRC staff has determined that no security-related or proprietary information is contained herein.

Thanks
Tekia

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Request for Additional Information

Fukushima Lessons Learned Flood Hazard Reevaluation Report

River Bend Station, Unit No.1 (TAC No. MF3675)

By letter dated March 12, 2014, Entergy (the licensee) submitted its flood hazard reevaluation report (FHRR) for River Bend Station, Unit No. 1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14073A649). By letter dated June 16, 2014, the U.S. Nuclear Regulatory Commission (NRC) staff provided a request for additional information (RAI) regarding the above referenced FHRR (ADAMS Accession No. ML14153A392). The licensee responded to this RAI by letter dated June 17, 2014, and the licensee provided NRC staff access to electronic reading room files by September 5, 2014. The staff determined that additional information, as requested below, is necessary to complete its assessment of the licensee's FHRR.

RAI Item 1, Local Intense Precipitation: PMP Hyetograph and Sensitivity Analysis

Background: The LIP flood reevaluation in the FHRR used a 1-hour, front-loaded probable maximum precipitation (PMP) event based on the Hydrometeorological Report Nos. 51 and 52. For the PMP hyetograph, the FHRR extended the 1-hour event by following it with steady precipitation based on a 6-hour PMP.

Request: Conduct a sensitivity analysis on the LIP event duration to consider localized (one square mile) 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-loaded and others in addition to a front-loaded distribution). The evaluations should identify potentially bounding scenarios with respect to flood height, event duration, and associated effects.

RAI Item 2, Local Intense Precipitation: West Creek Inflow

Background: Concerning the treatment of the modeled representation of West Creek in the FLO-2D model, AREVA Document No. 32-9207353-000 section 2.1.1 states that the LIP subwatershed for West Creek was delineated at a point approximately 400 ft (131m) upstream of the mouth of the channelized portion of the creek. However, the inflow hydrograph for West Creek was added to the inflow grid element directly upstream of the channelized section in FLO-2D.

Request: Discuss the conservatism of locating the West Creek inflow node at the mouth of the channelized portion of West Creek as opposed to where the inflow from the creek enters the grid system, along the computational boundary. Discuss the effect that backwater from Grants Bayou into West Creek has on the model and how conservatism is employed in the model to appropriately represent this.

RAI Item 3, Local Intense Precipitation: Vehicle Barrier System (VBS) Simulation

Background: FHRR section 3.1.2.1.2 states that "simulation of the LIP with the VBS results in a more conservative water surface elevation than without the VBS." The staff did not find the FLO-2D model to represent a VBS within the Unit 2 Excavation.

Request: Provide a quantitative comparison of the peak water surface elevations at critical points. Justify the assumption that certain portions of the VBS (e.g., the pedestrian crossing along the southern edge of the VBS) remained open during the LIP event.

RAI Item 4, Local Intense Precipitation: Precipitation onto Buildings

Background: Width Reduction Factors (WRFs) and Area Reduction Factors (ARFs) were assigned to grid elements representing buildings at RBS in the FLO-2D model. Grid elements that were completely within the extent of a building were blocked with WRFs and ARFs set equal to 1.0. Elements partially within the extent of a building were either completely blocked or completely open. FHRR section 3.1.2.1.2 states that FLO-2D calculates runoff from blocked grid elements and translates such runoff to the nearest unblocked grid element; however, it is not clear how and where rainfall onto the interior building elements is distributed to these unblocked grid elements. Previous staff experience has indicated discrepancies between how software documentation states that rainfall runoff is handled and how the selected model configuration produces those desired effects. Further clarification is required to ensure the selected model configuration matches physical characteristics at the site to ensure consistency, conservatism, and realism. The staff recognizes the coding issues for rainfall on roofs within FLO-2D for model builds before 2014. Before being re-coded in 2014, FLO-2D did not allow water to move outside the building perimeter.

Request: Provide a detailed description of how rainfall is routed to the nearest unblocked grid element in FLO-2D. Clarify or reanalyze how rainfall onto building roofs is physically routed at the River Bend Station and demonstrate that the model implementation accounts for roof runoff in a manner consistent with physical reality. Provide a figure showing locations of roof discharge onto the site yard. If building rainfall is routed to a concentrated discharge point, provide a discussion of how the model conservatively simulates localized flooding impacts due to concentrated discharge, and, if necessary, provide sensitivity analysis results that demonstrate the significance of localized flooding impacts from roof discharge. Describe the extent to which the model restricts building rainfall volume from entering the site yard due to the selected reduction factors (i.e., demonstrate whether there is a significant backwater effect at the building interface).

RAI Item 5, Local Intense Precipitation: Manning's Roughness Coefficient

Background: A Geographic Information System shapefile was created by assigning Manning's roughness coefficients to the apparent land cover classes based on visual assessment of high resolution ortho-imagery. The Manning's roughness coefficients used were based on Table 1 in the FLO-2D Reference Manual. The FHRR states that the upper range values of the Manning's Roughness Coefficients were used. Further comparison between Table 1 from the FLO-2D Reference Manual (Appendix A, Document No. 32-9207350-000) and the calculated Manning's roughness coefficients for the site (Table 3, Document No. 32-9207350-000) shows that the upper range of each roughness coefficient was not always used.

Request: Provide a detailed description of how Manning's roughness coefficients were selected for each land cover class. Provide a discussion on the conservatism (relative to onsite effects from LIP) of using upper or lower Manning's roughness coefficients for various land cover classes and in specific site locations.

RAI Item 6, Streams and Rivers: Probable Maximum Flooding

Background: The licensee included in the FHRR modeling of PMF flooding at RBS using HEC-RAS (v.4.0) for three separate watersheds – the Mississippi River watershed, Grants Bayou watershed, and the West Creek watershed. The licensee modeled individual PMF scenarios for each of the three watersheds. The FHRR does not include analysis of modeling of PMF flooding considering combined watersheds.

Request: Demonstrate whether combined or independent analysis of the three watersheds is more conservative and appropriate.

RAI Item 7, Streams and Rivers: Manning's Roughness Coefficient for the Mississippi River

Background: The description of the PMF analysis in FHRR Section 3.2.2.1.2 states that Manning's roughness coefficient was adjusted during HEC-RAS hydraulic model calibrations for the Mississippi River. The staff was unable to find details in the FHRR on how the licensee performed this adjustment, which were the final coefficient values that were used, and how was the adequacy of the final coefficient values determined.

Request: Provide additional details on the analysis and selection of the Manning's roughness coefficient values; and, describe how those values compare with recommended values in standard references for the Mississippi River near RBS.

RAI Item 8, Streams and Rivers: Baseflow

Background: The FHRR assumes that baseflow for West Creek and Grants Bayou is negligible in comparison to the peak PMF flow rates. The staff was not able to find information that the licensee modeled the baseflow for the two watersheds in HEC-RAS for the PMF water surface elevation calculations.

Request: Provide substantiation for the assumption that baseflow for West Creek and Grants Bayou is negligible. Demonstrate whether omission of baseflow from the PMF simulation adversely affects the conservatism of the water surface elevation estimate.

RAI Item 9, Streams and Rivers: Bridges

Background: The Louisiana State Highway 10 Bridge over Grants Bayou is modeled as 50 percent blocked by debris. All other bridges downstream of RBS on Grants Bayou are assumed in the FHRR to be completely blocked. Bridges and culverts upstream of RBS are ignored and not modeled for the PMF peak water surface elevation simulation.

Request: Discuss the decision to exclude bridges and culverts upstream of RBS from the model and the conservatism of this approach as it relates to backwater of the river. Justify modeling the Louisiana State Highway 10 Bridge as only 50 percent blocked by debris; provide calculations showing the conservatism or need of this approach rather than modeling the bridge as 100 percent blocked by debris.

RAI Item 10, General: Unit 2 Excavation during PMF

Background: In the FHRR analysis of the site LIP and PMF, the Unit 2 Excavation is modeled as a storage area in HEC-RAS and acts as a receiving area for flow that overtops West Plant Road (FHRR Section 3.2.2.3.3), which decreases the effective flood depth on site. Examination of the HEC-RAS files for the West Creek shows that the Unit 2 Excavation is considered dry at the beginning of the model (i.e., there is no standing water in the area to add to the PMF water level). This is also stated in the FHRR (Section 3.1.2.1.2) for the FLO-2D analysis. The FHRR mentions RBS Procedure OSP-0031 as the basis for this initial dry setting. Since the PMF is a flood resulting from the PMP, it is possible that water will accumulate within the Unit 2 Excavation prior to the start of the PMF, therefore affecting the final flood elevation due to PMF at RBS.

Request: Justify modeling the Unit 2 Excavation with no initial standing water conditions. Provide documentation that supports the Unit 2 Excavation being credited as a flood protection feature in the design basis. Provide information on whether the feature is considered permanent or whether its relevant characteristics and/or function could change in the future.

RAI Item 11, Dam Failures: Total Volume Storage Methodology

Background: The FHRR adopted methodology from the Guidance for Assessment of Flooding Hazards Due to Dam Failure Report (NRC, 2013) for use in the RBS dam failure analysis (FHRR Section 3.3.2). The ISG presents three simplified dam failure modeling approach methods: 1) volume, 2) peak outflow without attenuation, and 3) peak outflow with attenuation. The FHRR models dam failure using suggested steps outlined from both the volume and peak outflow without attenuation methods. The FHRR approach uses the total upstream reservoir volume approach (as outlined for the volume method) but uses regression equations to calculate breach outflow (as outlined for the peak outflow method). Following the peak outflow method by summing individual peak outflows from each upstream dam may provide more conservative results than the FHRR approach of calculating peak outflow for a single "combined" dam breach failure.

Request: Justify combining concepts from the two recommended ISG dam failure analysis methods. Discuss conservatism relative to modeling a dam breach outflow based on the total storage volume of a hypothetical dam versus modeling the cumulative outflow resulting from individual upstream dam peak breach outflows. Describe whether the limit to which the regression equations are applicable applies to a dam of the size assumed in this analysis. Provide any supporting calculations and sensitivity analysis.

RAI Item 12, Dam Failures: Antecedent Conditions

Background: The ISG volume and peak outflow without attenuation methods for analyzing dam failure recommend setting antecedent conditions at the site equal to the water surface elevation caused by a 500-year flood. Since the FHRR conservatively modeled the dam failure analysis during the PMF rather than the 500-year flood, the initial conditions at River Bend presumably should be the water surface elevation calculated during the PMF analysis, but the staff did not find the FHRR information to indicate what was used. The staff did not find that the HEC-RAS dam failure input/output files show any assumed conditions at the site.

Request: Provide clarification of the antecedent conditions at RBS implemented in the dam failure analysis model.

RAI Item 13, Combined Effects: Wind Speed

Background: A Gumbel Distribution was applied to the 2-minute wind speed data from the National Climatic Data Center (NCDC) to determine the 2-year return period wind speed.

Request: Discuss the decision to apply the Gumbel Distribution to wind speed data. Compare the results from the Gumbel distribution to other widely used distributions such as the Weibull Distribution.

RAI Item 14: General: CLB and CDB

Background: The FHRR refers to the current licensing basis (CLB) and the current design basis (CDB) variously and in some instances without reference. For example, FHRR Tables 4.1-1, 4.1-2, and 4.1-4 refer to the CLB and compare the CLB to the reevaluated flood hazard. A comparison between the CDB and the reevaluated flood hazard is described in the instructions that are provided in the 50.54(f) letter. It is not clear to the staff whether the CLB and CDB are the same or different, and if different, what distinguishes them in the way that they are used in the FHRR.

Request: 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.

RAI Item 15, General: Integrated Assessment Hazard Input

Background: The FHRR identified local intense precipitation and PMF from streams and rivers (West Creek due to PMP) as flooding causing mechanisms that could potentially expose flood hazard to RBS. The staff did not find the FHRR to provide warning times, duration of inundation of the site, or time for flooding water to recede from the site (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). 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.

Request: Clarify which flood causing mechanism and associated effects, if applicable, will be included in the Integrated Assessment. Provide the applicable flood event duration parameters associated with each mechanism that triggers an integrated assessment using the results of the flood hazard reevaluation. 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.

<u>RAI Item 16, General: Drainage Divides</u>

Background: In Table 4.1-1, based on elevation alone, the Grants Bayou PMF water level would trigger inclusion in the Integrated Assessment. The text on FHRR Section 4.1.9 (page 4-5) provides partial explanation of this as a non-issue; and, the elevation of a "drainage divide" that prevents the Grants Bayou PMF from reaching the site is mentioned earlier in FHHR Section 3.2.2.2.3 (page 3-12). This elevation is discussed in a calculation package, but is needed relative to the FHRR. Also, with respect to West Creek (FHRR Section 3.2.2.3.3), "[t]he top elevation of West Plant Road [WPR] drainage divide at the lowest point is 93.5 ft NAVD88 (AREVA, 2013a)." It is not clear to staff whether this is a single point or a length of road.

Request: Provide delineation of site drainage divides, with pertinent elevation information, important to the reevaluation; and, where appropriate, whether each drainage divide provides a protected level in the design basis. Provide a figure to include visual reference to drainage divides mentioned in the text; and, clarify in Table 4.1-1 whether the Grants Bayou PMF, with and without wind and wave effects, is separated from the site by a drainage divide with a stated elevation or range thereof. Provide a figure showing the WPR drainage divide low point. Provide clarity to staff whether the WPR low-point this is a single point or a length of the road.