NRR-PMDAPEm Resource

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Sent: Wednesday, November 08, 2017 5:37 PM
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Subject: RIVER BEND STATION, UNIT 1 - LICENSE RENEWAL SEVERE ACCIDENT MITIGATION ALTERNATIVES REQUESTS FOR ADDITIONAL INFORMATION (EPID L-2017-LNE-0026)
Attachments: E-MAIL - RBS SAMA - RAI email - enclosure.pdf

Dear Mr. Maguire:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing the Entergy Operations, Inc. (Entergy) application for renewal of the operating license for River Bend Station, Unit 1 (RBS). As part of the environmental review, a severe accident mitigation alternatives (SAMA) audit was conducted at RBS, by NRC staff, during the week of October 23, 2017. As a result of the audit and the NRC staff's review of the RBS environmental report, staff identified areas where additional information is needed to complete the review. The enclosure lists the SAMA requests for information.

The NRC staff transmitted this information to Rick Buckley, Entergy, by e-mail on November 7, 2017. Please provide the responses 30 days from the date of this e-mail.

If you have any questions, please contact me by telephone at 301-415-6223 or by e-mail at David.Drucker@nrc.gov.

Sincerely,

David Drucker, Sr. Project Manager
License Renewal Projects Branch
Division of Materials and License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-458

Enclosure: SAMA Requests for Additional Information

cc w/encl: Distribution via Listserv

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Subject: RIVER BEND STATION, UNIT 1 - LICENSE RENEWAL SEVERE ACCIDENT MITIGATION ALTERNATIVES REQUESTS FOR ADDITIONAL INFORMATION (EPID L-2017-LNE-0026)
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RIVER BEND STATION, UNIT 1
SEVERE ACCIDENT MITIGATION ALTERNATIVES
REQUESTS FOR ADDITIONAL INFORMATION

1. Provide the following information regarding the Level 1 Probabilistic Risk Assessment (PRA) used for the River Bend Station (RBS) Severe Accident Mitigation Alternatives (SAMA) analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs if not previously considered in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analysis, Nuclear Regulatory Commission (NRC) staff evaluates the applicant's treatment of internal events and calculation of core damage frequency in the Level 1 PRA model. The requested information is needed for the NRC staff to determine the sufficiency of the applicant's Level 1 PRA model for supporting the SAMA evaluation.

    a. Section D.1.1 states, "This model reflects the RBS as-built, as-operated configuration as of April 30, 2009 [D.1- 4]. No other planned major plant modifications, which could adversely impact the SAMA analysis results, have been identified." Clarify the intent of this statement relative to any changes made to plant operations, procedures and/or physical modifications in the eight years since the stated configuration date and any planned future changes and their potential impact on the SAMA analysis.

    b. Section D.1.4.8 indicates that plant specific data and initiating events frequencies through April and May 2009 were incorporated in the RBS Revision 5 (R5) PRA. Section D.1.4.9 did not cite any further data updates made to RBS R5A. Section D.1.4.11 states, "Plant specific initiating event frequencies, failure rates, and maintenance unavailabilities are updated regularly. EN-DC-151 suggests an update frequency of approximately every four years." Discuss the current status of the plant specific data and initiating event frequency updates and the potential impact on the SAMA analysis.

    c. Identify the RBS PRA revision that was reviewed in the 2011 peer review. If not RBS R5, provide additional information on the revision reviewed including core damage frequency (CDF), large early release frequency (LERF), and major changes to produce PRA RBS R5A.

    d. Confirm that no changes have been made to the RBS model used in the SAMA analysis since the peer review that would constitute an upgrade as defined by American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) RA-Sa-2009, as endorsed by RG 1.200, Revision 2.

    e. Discuss the various systems available to RBS that were not part of the original design basis or have been added as part of various industry programs to address beyond-design-basis events and the extent they are credited in the SAMA PRA.

2. Provide the following information relative to the Level 2 PRA analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs if not previously considered in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analysis, NRC staff evaluates the

applicant's treatment of accident propagation and radionuclide release in the Level 2 PRA model. The requested information is needed in order for the NRC staff to determine the adequacy of the applicant's Level 2 PRA model for supporting the SAMA evaluation.

a. Source term categories (STCs) 5 and 6 are for large ruptures of containment while STCs 7 through 14 are for penetration failures. Briefly discuss the analysis of containment integrity that lead to these STC assignments and how this was modeled in the Level 2 PRA.

b. Section D.1.2.3.2 states that "...that the frequency for STC 1, Intact Containment, has been increased to account for the difference between the Level 1 CDF and the total calculated Level 2 frequency." The difference being due to the impact of truncation on the Level 2 cutsets. Provide support for the assignment of this difference to STC 1, which has a low risk compared to other STCs, and discuss the impact of assigning these unaccounted for sequences to other STCs.

c. The discussion of the representative Modular Accident Analysis Program (MAAP) cases for STCs 9 and 10 (containment failed prior to vessel breach, late molten core concrete interactions (MCCI)) cite MAAP cases S2A-6, T-TB-1, T-TB-2, T-14 and T1-4. Similarly, for STCs 11 through 14 (containment intact at vessel breach, with and without MCCI) MAAP cases T-TB-3, RCIC-Inj, T-TB-6, T-TB-9, and T-51and T-51-CV are cited. Provide a description of each of these cases including how late molten core concrete interaction (MCCI) is modeled, the frequency of the sequences that they represent, and discuss if there are any other sequences that could be important for evaluating the benefit of potential SAMAs.

d. The discussion of the representative MAAP cases for STCs 7 through 10 indicates that the same MAAP case (T-14) was used for both no MCCI categories, as well as those with MCCI. Similarly, for STCs 11 through 14, the same MAAP case (T-TB-3) was used for both no MCCI categories, as well as those with MCCI. However, the release fractions for otherwise similar categories (STC 7 and 9, STC 8 and 10, STC 11 and 13; as well as STC 12 and 14) are different, even though from the same MAAP case. From the discussion in the ER, it appears that the results prior to MCCI were used for the no MCCI categories while the results at the end of the run were used for the MCCI categories. Please clarify this and justify the use of MAAP results prior to MCCI occurring for the no MCCI categories rather than the end of run result for a MAAP case without MCCI.

e. Table D.1-7 gives a noble gas release fraction of 0.018 for STCs 11 and 12 (containment intact at vessel breach, no MCCI) as obtained from MAAP case T-TB-3. This result is much less than that for STC 1, intact containment. Discuss the modeling of no MCCI scenarios and explain this low noble gas release fraction result.

f. Section D.1.2.3.1, with regard to the MAAP analysis of fission product release, states "In general, cases were run to a minimum of 140 hours to ensure that any late MCCI effects are understood. Provide the MAAP run times for each STC, as well as the time of declaration of a general emergency, the time of core damage, the time of containment failure and the time of the start of release. Also, clarify the meaning/definitions for the plume durations and plume delays given in

Table D.1-21. If any of the run times are less than 48 hours after the time of declaration of general emergency justify the duration of the run time.

g. Section D.1.4.10 states that the LERF model was peer reviewed in July 2011. Section D.1.2.1 states, with regard to the Level 2 PRA, that "It was prepared and reviewed by qualified personnel in accordance with existing industry standards" and further...a team of RBS experts representing various site organizations (e.g. Operations, System Engineering, Mechanical/Safety Analysis, PRA License Renewal) performed a review of the results to confirm that the model is representative of the plant and the results are reasonable." Discuss the results of any self-assessment of the LERF portion of the Level 2 PRA model against the LERF requirements of the ASME/ANS PRA standard.

h. Section D.1.2.2 states that, "Each Level 1 CDF accident sequence was grouped into one of six groups for use in the Level 2 analysis." Discuss how Level 1 station blackout (SBO) sequences were treated in the Level 2 analysis.

3. Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs if not previously considered in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analysis, NRC staff evaluates the applicant's treatment of external events in the PRA models. The requested information is needed in order for the NRC staff to determine the sufficiency of the applicant's PRA models for supporting the SAMA evaluation.

   a. In the ER, Entergy reported a RBS seismic CDF (SCDF) of 2.5E-06/Rx-yr using more realistic plant specific fragility values instead of the more conservative values used by the NRC in the GI-199 safety/risk assessment. Provide more information on, and support for, these more realistic fragility values.

   b. Section D.1.3.4 indicates that the internal flood analysis was revised and updated in 2012. Identify the internal events model used in this updated flood analysis, characterize it with respect to the internal events model used in the SAMA analysis (RBS 5A), and assess the impact of any difference between the two models.

   c. Section D.1.4.10 indicates that the majority of the supporting requirements assessed as "not met" in the 2011 peer review were related to internal flooding. Further Section D.1.4.11 states "... following each periodic PRA model update, Entergy performs a self-assessment to assure that the PRA quality and expectations for all current applications are met." Discuss the results of the self-assessment of the 2012 internal flood model as well as the status of meeting those requirements "not met" in the 2011 peer review. For any internal flood requirements "not met" discuss the impact on the SAMA analysis.

   d. Following the accident at the Fukushima Daiichi nuclear power plant, Entergy responded to an NRC 10 CFR 50.54(f) request for information. This response included a reevaluation of the external flood hazards, the development of mitigating strategies for external floods and a focused evaluation of the external flooding mechanisms for which the re-evaluated flooding hazards is not bounded by the current design basis. Entergy's evaluations concluded that permanent passive

protection is in place for the Probable Maximum Flood (PMF) on West Creek and PMF on the Mississippi River and the Local Intense Precipitation (LIP) flood-causing mechanisms (Entergy, June 28, 2017, ADAMS Accession No. ML17207A105). This focused evaluation was a deterministic (that is, not a probabilistic) evaluation. Provide a discussion of these external flood hazards and the associated impact on RBS to support the conclusion that they would not contribute to the external events multiplier nor lead to any cost-beneficial SAMAs.

4. Please provide the following information regarding the Level 3 PRA used in the SAMA analysis. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs, if not previously considered, in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analyses, NRC staff evaluates the applicant's analysis of accident consequences in the Level 3 PRA. The requested information is needed in order for the NRC staff to reach a conclusion on the sufficiency of the applicant's Level 3 PRA model for supporting the SAMA evaluations.

    a. ER Table D.1-32 provides the results of several sensitivity analyses. The change in population dose risk is reported to be unchanged from the base case (1.21 person-rem/year) for all of the sensitivity analyses. No explanation is provided for this non-intuitive result, especially for those sensitivity cases that would have been expected to have some impact on the population dose risk (i.e., evacuation speed, fraction of public evacuating, and time to declaration of a general emergency). For each of the sensitivity cases, explain why there is no impact on the population dose risk. Also, provide the decontamination time (TIMDEC) value assumed in the baseline SAMA analysis.

    b. Table D.1-16 provides the estimated core inventory input to the Level 3 analysis. Clarify whether adjustments of the core inventory values are necessary to account for differences between fuel cycles expected during the period of extended operation and the fuel cycle upon which the Level 3 analysis is based (e.g., to account for any changes in future fuel management practices or fuel design).

    c. Section D.1.5.2.6 indicates that meteorological data for the year 2013, the most conservative data set for the years 2008 through 2014, was used in the consequence analysis. Discuss the basis for the conclusion that the year 2013 data is the most conservative, the extent to which there was missing data, and how missing data was accounted for in the SAMA analysis.

5. Provide the following information with regard to the selection and screening of Phase I SAMA candidates. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs if not previously considered in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analysis, NRC staff evaluates the applicant's basis for the selection and screening Phase I SAMA candidates. The requested information is needed for the NRC staff to determine the adequacy of the applicant's Phase I SAMA selection and screening process for the SAMA evaluation.

    a. The ER indicates that, based on the best available information, the CDF for each of the external events (seismic, internal fire and internal floods) are approximately equal to, or greater than, the internal events CDF. Discuss the steps taken to

identify potential SAMAs that would mitigate the RBS specific risks due to these hazards.

b. Address the following with respect to the review of the importance analysis in ER Table D.1-2

   i. Event E12-MDP-MA-C002A "[Residual heat removal] RHR pump A is unavailable due to maintenance" is addressed by a number of SAMAs that are either not applicable to this event (SAMAs 79 and 198) or involve costly new systems (SAMAs 110, 115 and 120). Consider other alternatives to mitigate this event such as eliminating or reducing on-line maintenance of the RHR pump.

   ii. Event FPW-XHE-LO-T2SBO "operator fails to follow attachment 2 for [station black out] (SBO)" is addressed by several hardware modifications. This event is given a failure probability of 0.5 and has a fairly high RRW of 1.117. Discuss the potential for a SAMA to improve the procedure or training. [Note: Phase I SAMA 72 to improve training on alternate injection via the fire water system was screened out as already installed. Also, it would appear that fire water injection into the reactor vessel would be important for increasing the likelihood of preventing molten core concrete interaction.]

   iii. For Event IE-T3C "Initiator, Inadvertent opening of SRV," is addressed by SAMA 108 - Improve [safety relief valve] SRV and [main steam isolation valve] MSIV pneumatic components and SAMA 160 - Increase SRV reseat reliability. It is not clear that either of these SAMAs address this event. Discuss the potential for other SAMAs that address or mitigate this event.

   iv. It is noted that the table includes a number of standby service water (SSW) pumps B and D failure events but not any events for failure of SSW pumps A or C. Explain the reasons for this difference and discuss if the reasons suggest any potential SAMAs.

   v. Event SWP-MOV-CC-F055A "motor operated valve [MOV] 1SWP*MOV55A fails to open on demand" is said to be addressed by SAMAs 75 and 80, both of which pertain to the service water pumps. Discuss the potential for a SAMA for the operator to manually open the valve.

   vi. For ADS-XHE-FO-INDIV "operator fails to start ADS by opening individual ADS valves or SRVs," consider improvements in procedures and training.

c. The disposition of a number of late large release Level 2 risk significant terms in Table D.1-5 states, "This item is a split fraction. No SAMAs need to be correlated." While these events are in some cases related to deterministic phenomenological analysis or assumptions and not hardware or other failures, they do indicate the importance of a number of these events and the associated assumptions. In addition, as indicated by the base case risk results, source term categories (STCs) 9 and 10 dominate the risk and involve penetration failures with and without scrubbing in the auxiliary building. It would therefore appear that steps that could be taken to reduce the impact of these STCs should be considered. For example, consideration of means to increase the likelihood or effectiveness of scrubbing in

the auxiliary building in the area of the penetrations would appear worthwhile. Discuss this particular example and the more general question addressing potential SAMAs suggested by review of the Level 2 split fractions.

d. From the information in Tables D.1-1 and D.1-2 the frequency of initiating event IE-TNSW, Failure of the Normal Service Water (NSW)/Service Water Cooling (SWC) System, is an input into the internal events PRA as a value rather than as a fault tree model. The basic events that contribute to this frequency will therefore not appear in the list of risk significant terms in Table D.1-2. Describe NSW and SWC systems, their operation, and modeling in the PRA, particularly with respect to operation in hot weather and discuss the identification of candidate SAMAs, other than SAMA 197 (Generation Risk Assessment implementation into plant activities), that would mitigate the risk of this initiator.

e. Section D.2.1 indicates that the initial list of SAMA candidates was developed from the review of a list of industry documents. Provide additional information on how this review was performed and how the decision was made to include individual items in the Phase I list. Specifically address:

   i. Which potential plant improvements from the 13 other SAMA evaluations were considered.

   ii. The inclusion of items from the RBS Individual Plant Examination (IPE) or Individual Plant Examination of External Events (IPEEE) or NUREG-1742.

   iii. How the RBS updated PRA list of significant contributors (the RRW correlation tables) were examined to identify RBS plant specific SAMA candidates as opposed to generic or other plant SAMAs.

f. The RBS IPEEE did not identify any fire related vulnerabilities or improvements, however, five "enhancements" were identified. Discuss the status of the implementation of these "enhancements."

g. During the audit the NRC staff reviewed the process for identification and disposition of Phase I SAMA candidates. Address the following with regard to this process:

   i. SAMA 93 regarding heating ventilation and air conditioning (HVAC) discusses a recent analysis of control building shows reduced HVAC importance and that this SAMA does not consider the control building loss of HVAC. This is also stated for SAMA 94 involving enhanced loss of HVAC procedures. Clarify the results of the recent analysis that supports this disposition.

   ii. SAMA 120, to install a hardened containment vent, cites a containment vent study. Describe this study, its scope and results. In addition, Section D.1.4.8 mentions the deletion of credit for a 3-inch containment vent. Describe and discuss the current status of this vent path.

   iii. SAMA 170 to increase seismic ruggedness of plant components is stated to be already installed based on improving RBS components whose seismic

ruggedness could be improved and was identified in the IPEEE. The RBS IPEEE does not identify any such components. Discuss the potential for reducing seismic risk by improving seismic ruggedness of selected RBS components.

6. Provide the following information with regard to the Phase II cost-benefit evaluations. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(3) (ii)(L) to consider SAMAs if not previously considered in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analysis, NRC staff evaluates the applicant's cost-benefit analysis of Phase II SAMAs. The requested information is needed in order for the NRC staff to determine the acceptability of the applicant's cost estimations for individual SAMAs and cost-benefit evaluation

    a. Describe what changes/modifications are associated with the implementation of SAMA 38, Protect service transformers from failure evaluated by Case 9. Address whether the scope of this modification can be reduced to obtain the same or similar benefit.

    b. Case 19 evaluates the benefit of SAMA 87, Install digital feedwater upgrade, by setting the loss of feedwater system initiating event (IE-T3B) to false in the base model Level 1 and Level 2 cutsets. Discuss the potential for additional benefit of the upgrade resulting from the reduction in the potential for loss of feedwater following other initiators.

    c. SAMA 183, add automatic fire suppression (specifically, addition of incipient detection and suppression division 1 switchgear (Div 1 Swgr) Room), and SAMA 185, upgrade the alternate shut down system (ASDS) panel to include additional system controls for opposite division, were evaluated in Cases 36 and 37 by eliminating the contribution to CDF from the respective fire zones. Address the following with respect to these two SAMA and cases:

        i. Case 37, Reduce Risk from Fires That Require Control Room Evacuation, was used to evaluate the benefit for SAMA 185 by assuming this SAMA eliminated Control Room fires from the RBS fire CDF. It is noted that fires other than in the control room may require control room evacuation and could benefit from the upgrade of the ASDS panel. Identify the other control room abandonment areas and discuss the impact on the cost-benefit analysis of SAMA 185 from crediting the risk reduction benefit of this SAMA for the identified abandonment areas.

        ii. The benefit for these two fire related cases was determined based on the assumption that the percentage reduction in person-rem risk and offsite economic risk (OECR) is the same as the percentage reduction in CDF. An examination of the results for the risk reductions given in Table D.2-1 indicates that this assumption is not necessarily conservative. Depending on the case, the reduction in OECR is often a factor of 1.1 to 1.4 times the CDF reduction. For Case 17 the OECR reduction is 2.4 times the CDF reduction. Discuss the impact of this assumption on the cost-benefit analyses of SAMAs 183 and 185.

7. For certain SAMAs considered in the RBS Environmental Report, there may be lower cost or more effective alternatives that could achieve much of the risk reduction. In this regard, provide an evaluation of the following SAMAs. The basis for this request is as follows: Applicants for license renewal are required by 10 CFR 51.53(c)(3)(ii)(L) to consider SAMAs if not previously considered in an environmental impact assessment, related supplement, or environmental assessment for the plant. As part of its review of the RBS SAMA analysis, NRC staff considers additional SAMAs that may be more effective or have lower implementation costs than the other SAMAs evaluated by the applicant. The requested information is needed in order for the NRC staff to determine the adequacy of the applicant's determination of cost-beneficial SAMAs.

    a. SAMA 34, Provide alternate feeds to essential loads directly from an alternate emergency bus, is evaluated using a plant-specific cost estimate of $2.3M. Case 4, evaluating this SAMA, is stated in ER Section D.2.3 to assume an added independent AC [alternating current] power source to each safety-related 4160v bus. Clarify the scope of the design used for the cost estimate and, if it includes independent supplies to all safety-related buses, consider the cost-benefit of a design that included a supply to only a single safety-related 4160v bus.

    b. SAMAs 80, 110, 115, and 120 all involve major new systems to mitigate loss of cooling events and are cited for a large number of significant basic events in Table D.1-2 including, for example: SWP-XHE-FO-RETRN, Operator fails to open SWP manual isolation valve before containment over-pressurization failure, SWP-XHE-RE-F055A, operator fails to restore XOV downstream of F055A, and E12-MOV- OO-F048A, water diverted from RHR A HXS because bypass valve MOV F048A fails to close. Describe these events and other similar events regarding the possibility of lower cost alternatives such as: simpler hardware changes, changes in system operation in order that fewer changes in valve position are necessary, and/or procedure and training improvements.