From: Chawla, Mahesh

Sent: Monday, May 16, 2022 4:51 PM

To: 'Elwood, Thomas B'

Cc: Jackson, Christopher; Seymour, Jesse; Jones, Steve; Parillo, John; Mazaika, Michael; Cintron-Rivera, Jorge; McConnell, Matthew; Zhao, Jack; Basavaraju, Chakrapani; Hamm, Matthew; Yoder, Matthew; Scully, Derek

Subject: DRAFT - Request for Additional Information - Callaway Plant, Unit 1 - License Amendment Request for Adoption of Alternate Source Term and Revision of Technical Specifications - EPID L-2021-LLA-0177

Attachments: Callaway LAR Draft RAIs .docx

Dear Mr. Elwood,

By letter dated September 28, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21272A167), supplemented by letter dated December 1, 2021 (ML21335A452), Union Electric Company, dba Ameren Missouri (the licensee) submitted a license amendment request (LAR) for Callaway Plant, Unit No. 1 (Callaway) to the U.S. Nuclear Regulatory Commission (NRC). Pursuant to Title 10 of *Code of Federal Regulations* (10 CFR) Section 50.90, “Application for amendment of license, construction permit, or early site permit,” and 10 CFR 50.67, “Accident Source Term,” the licensee requested, in part, to incorporate the alternate source term (AST) dose analysis methodology into the Callaway licensing basis. In order to complete their review of the application, the NRC staff is requesting additional information, attached herewith. Please arrange a clarification call with the NRC staff to discuss the attached information. Thanks

Sincerely,

Mahesh Chawla, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
ph: 301-415-8371
Docket No. 50-483

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Request for Additional Information
Callaway Plant, Unit 1
License Amendment Request for Adoption of Alternate Source Term and Revision of Technical Specifications

By letter dated September 28, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21272A167), supplemented by letter dated December 1, 2021 (ML21335A452), Union Electric Company, dba Ameren Missouri (the licensee) submitted a license amendment request (LAR) for Callaway Plant, Unit No. 1 (Callaway) to the U.S. Nuclear Regulatory Commission (NRC). Pursuant to Title 10 of *Code of Federal Regulations* (10 CFR) Section 50.90, "Application for amendment of license, construction permit, or early site permit," and 10 CFR 50.67, "Accident Source Term," the licensee requested, in part, to incorporate the alternate source term (AST) dose analysis methodology into the Callaway licensing basis. In order to complete their review of the application, the NRC staff is requesting the following information:

EXTERNAL HAZARDS BRANCH RAI

REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO OFFSITE AND ONSITE DISPERSION ANALYSES

BACKGROUND INFORMATION:

During its acceptance review, the NRC staff identified that it required additional data and information to be able to confirm direct input to the licensee's radiological dose evaluation. In particular, data and information comprising the accident-related offsite and onsite atmospheric dispersion models and the meteorological (Met) data input to them were needed. These needs were discussed during previous pre-application submittal meetings. A request for supplemental information was provided to the licensee on November 4, 2021 (ML21308A069). The data and information were submitted by the licensee on December 1, 2021 .

REGULATORY BASIS

The regulation at 10 CFR 50.67(b)(1) states that "[t]he application shall contain an evaluation of the consequences of applicable design-basis accidents previously analyzed in the safety analysis report." In turn, the regulation at 10 CFR 50.67(b)(2) requires that "the applicant's analysis demonstrates with reasonable assurance" that the dose limits at any point on the exclusion area boundary (EAB) and the outer boundary of the low population zone (LPZ), and at the control room, are met. Those dose analyses require, as direct inputs, dispersion parameters, which are based on using appropriate dispersion models that rely, in part, on the input of representative Met data. The analyses above pertain to offsite impacts.

In addition, General Design Criterion 19, "Control room," in Appendix A to 10 CFR Part 50 applies, in part, to the analysis of onsite impacts at the control room and access to it during radiological accident conditions. Further, radiological protection equivalent to that at the control room is called for at the technical support center (TSC) by: NUREG-0696, "Functional Criteria for Emergency Response Facilities, Final Report," dated February 1981 (ML051390358) and by Supplement 1 to NUREG-0737, "Clarification of TMI [Three Mile Island] Action Plan Requirements," Supplement No. 1, dated January 1983 and reprinted February 1989 (ML102560009), Section 8.2.1. Item (f).

Guidance on implementing the overall AST methodology is given in:

- Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," Revision 0, July 2000 (ML003716792).

Guidance on modeling offsite dispersion parameters is given by:

- RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1 (November 1982), Reissued February 1983 (ML003740205).

- NUREG/CR-2858, "PAVAN – An Atmospheric-Dispersion Program for Evaluating Design-Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations, November 1982 (ML12045A149).

- NUREG/CR-2260, "Technical Basis for Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," October 1981 (ML12045A197).

Guidance on modeling onsite dispersion modeling parameters is given by:

- RG 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," Revision 0, June 2003 (ML031530505).

- NUREG/CR-6331, "Atmospheric Relative Concentrations in Building Wakes," Revision 1, May 1997 (ML17213A190).

Guidance on meteorological monitoring is given by:

- RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants," Revision 1, March 2007 (ML070350028).

<u>BACKGROUND INFORMATION - OFFSITE DISPERSION MODELING ANALYSIS</u>

The Licensee's offsite dispersion modeling analysis was based on the PAVAN-NAI code and used to estimate atmospheric dispersion factors (X/Qs) at the EAB and outer boundary of the LPZ. PAVAN-NAI appears to be essentially the same as the NRC-approved PAVAN dispersion model. PAVAN implements RG 1.145, the associated user's guidance in NUREG/CR-2858, and the technical basis document for the regulatory guide in NUREG-CR-2260. Enclosure 14 to the December 1, 2021, supplemental submittal discusses the differences between PAVAN-NAI and PAVAN. Slight differences between the input to and output of the two codes were determined and had to be accounted for in the NRC staff's initial review.

The Licensee chose to input Met data to PAVAN-NAI in the form of joint frequency distributions (JFDs) of wind speed, wind direction, and atmospheric stability. This is consistent with the NRC's PAVAN model. According to Enclosure 14, the other approach available in PAVAN-NAI is to input hourly Met data in the ARCON96 format, a provision not available in the PAVAN model. The period of record (POR) of onsite Met data covers four years from 2013 to 2016. Enclosure 1 of the December 1, 2021, supplemental submittal indicates that hourly atmospheric

stability values were determined consistent with RG 1.23 and that wind speed and direction values were determined by scalar (as opposed to vector) averaging.

The Licensee provided PAVAN-NAI input and output files that correspond to Enclosures 12 and 13, respectively, of the supplemental submittal. These files were in response to Question 21c from a June 14, 2018, pre-application meeting with the Licensee (ML18215A375). This question was reiterated during a second pre-application meeting on March 15, 2021 (ML21103A003).

The model runs evaluated accident releases from a variety of potential sources located close to the containment structure. The runs designated as "RB" and "RWST" model releases from the reactor building and refueling water storage tank, respectively. Distances to the EAB and LPZ are consistent with the distances from the midpoint between the Unit 1 reactor building and the cancelled Unit 2 reactor building to each offsite boundary as given in the UFSAR (i.e., 1,200 meters (m) and 4,023 m, respectively). PAVAN-NAI was configured to account for and to exclude enhanced building wake effects on plume dispersion, as available in the PAVAN model.

From these model runs, only the bounding X/Q values for the EAB and LPZ, as summarized in Table 3-23 (see Enclosure 1 of the supplemental submittal) and that account for building wake effects, appear to be directly input to the offsite dose analyses. Further, for the RB and RWST model runs, the respective 0- to 2-hour X/Qs in Table 3-23 are assigned to all averaging periods for the EAB distance.

Additional PAVAN-NAI input and output files were also provided in Enclosures 12 and 13. These files appear to be source- and distance-specific. Only one receptor distance is evaluated in these model runs, and the same distance is assigned, in a given model run, to all 16 direction sectors. The distances entered for these other runs presumably represent the distances to the EAB from a potential release point other than the RB or RWST and appear to correspond to sources modeled by the Licensee using the ARCON96-NAI code.

<u>RAI-1a</u>

An input error was identified in each of the RB, RWST, and additional PAVAN-NAI model runs. Tables 3-8 through 3-14 (see Enclosure 1 of the supplemental submittal) list the frequencies of calm wind conditions for stability classes A thru G in term of hours with wind speeds less than or equal to 0.5 meters per second (m/sec). They are: 0, 0, 0, 15, 85, 136, and 198, respectively. PAVAN-NAI appears to follow the format for Card Type 8 of the PAVAN code. Card Type 8 calls for these input entries to be right-justified every five (5) columns. Upon review, the first three entries for stability classes A, B, and C were determined to be 0, 0, 0, consistent with that format. Likewise, the last two entries for stability classes F and G were determined to be formatted correctly as 136 and 198, respectively.

However, the entry for stability class D (i.e., 15) was determined to be misaligned. The "1" digit was right-justified in the fourth input field but the "5" digit was placed in the first column of the fifth input field, followed by two blank spaces, and then the properly placed entry for stability class E (i.e., 85) right-justified in the fifth input field. The effect of this error was further complicated by what is believed to be differences between the compiler used for PAVAN-NAI and that for the NRC-approved PAVAN code. That is, "read" statements for the former appear to account for all entries within a given field even if the entries are not continuous. The value assigned by PAVAN-NAI to the fifth input field was "585". This was verified by inspecting each

of the PAVAN-NAI output files which echoed the input for Card Type 8 as “0, 0, 0, 1, 585, 136, 198”. The PAVAN echo in the output and X/Q values were different.

After recognizing and addressing the apparent difference in “read’ statements, the NRC staff was able to reproduce the Licensee’s X/Q results using the incorrect calm frequencies as input. The effect of this error on the offsite X/Qs was not immediately known because the discrepancies were associated with stability classes D and E. Nevertheless, the increase for stability class E was almost seven-fold. As a result, the influence on the X/Q frequency distribution was investigated because dose calculations could be directly affected. The NRC staff then re-ran the RB, RWST, and additional offsite model runs using the calm frequencies from Tables 3-8 thru 3-14 as input (i.e., 0, 0, 0, 15, 85, 136,198). The corrected results show that the offsite X/Qs at the EAB and LPZ in the LAR submittal are slight overestimates by about 3.5 percent or less depending on the release scenario, the receptor, and averaging time.

Therefore, the Licensee should either: (a) decide to let the PAVAN-NAI modeling results and related dose calculations stand unchanged from the September 28, 2021, LAR submittal, but formally acknowledge this error since the PAVAN-NAI input and output files were provided on the docket as supplemental information pursuant to the LAR’s acceptance, or (b) revise the PAVAN-NAI offsite dispersion modeling, and any affected dose calculations, related text, tables, and figures.

<u>RAI-1b</u>

Correct the labeling in Tables 3-9 through 3-14 of Enclosure 1 to the December 1, 2021, supplemental submittal. In the upper left-hand portion of these table bodies, the labels incorrectly read “Atmospheric Stability: Class A” for all seven stability classes (A to G). This discrepancy only affects the labeling, not the individual table contents or the table titles. The labels should be corrected to match stability classes B through G in the corresponding tables.

<u>RAI-1c</u>

Clearly explain the purpose and use of the PAVAN-NAI model input and output files (i.e., other than for the RB and RWST model runs) provided in Enclosures 12 and 13, respectively, of the supplemental submittal. This includes verifying: (a) what the distances entered in the input files are relative to (e.g., the EAB), (b) what potential source each run corresponds to, and (c) their relationship, if any, to the model runs using ARCON96-NAI.

<u>RAI-1d</u>

To avoid confusion and if the PAVAN-NAI modeling analysis is re-run based on RAI-1a, the NRC staff recommends that the second entry for Card Type 3 of the model input be changed from “Delta-T from 10-60m” to read “Delta-T from 60-10m”. This would be consistent with how the vertical temperature difference (Delta T) is calculated for determining the hourly stability class. The NRC staff verified, in this case, that the hourly Delta-T values reported in Enclosure 7 of the supplemental submittal and as used in the offsite and onsite dispersion modeling analyses, was determined correctly (i.e., based on the difference between the temperatures at the upper (60 m) minus the lower (10 m) measurement heights).

<u>BACKGROUND INFORMATION - ONSITE DISPERSION MODELING ANALYSIS</u>

The Licensee's onsite dispersion modeling analysis was based on the ARCON96-NAI code. This model was used to estimate X/Qs at the normal and emergency air intakes of the control building, at various points along the path of ingress and egress to the control building, and at the air intake to the TSC. As with PAVAN-NAI, ARCON96-NAI appears to be essentially the same as the NRC-approved ARCON96 dispersion model. ARCON96 implements RG 1.194 and the associated user's guidance in NUREG/CR-6331. Enclosure 14 to the December 1, 2021, supplemental submittal discusses the differences between ARCON96-NAI and ARCON96. Only slight differences between the input to and output of the two codes were observed during the NRC staff's initial review. The staff notes that model appears to have been run at different times during 2017 with the input / output files differing slightly after about July of that year although the same version number of the code (i.e., 1.1) is designated for all runs.

According to Enclosure 14, Met data were input to ARCON96-NAI in the prescribed ARCON96 format. The 2013 to 2016 POR of onsite Met data is the same as that used for the PAVAN-NAI modeling analysis. However, the staff notes that the wind speed units of measure as input to ARCON96-NAI is in miles per hour (mph) whereas the hourly data reported in Enclosure 7 to the supplemental submittal is in units of m/sec consistent with Appendix A of RG 1.23.

The Licensee provided ARCON96-NAI input and output files in Enclosures 9, 10, and 11 of the supplemental submittal in response to Question 22c from the previously referenced June 14, 2018, and March 15, 2021, pre-application meetings with the Licensee. These enclosures included 78 model runs (one input and two output files per run) to evaluate potential accident releases from sources generally designated by Items 3 through 14 and Item 16 as shown on Figure 3.1 of Enclosure 1 to the December 1, 2021, supplemental submittal. Modeled receptor locations were also generally identified on Figure 3.1 as Item 1 (consisting of emergency air intakes A and B and the midpoint between those two intakes), Item 2 (the normal air intake for the control room), and Item 15 (the air intake for the TSC).

In response to Question 19 from the previously referenced June 14, 2018, and March 15, 2021, pre-application meetings with the Licensee, Table 3-25 of Enclosure 1 lists, in part, various characteristics of the release/receptor pairs input to the ARCON96-NAI model runs. These inputs identify the respective release and receptor points, the horizontal distance between these points, the release and intake heights (in meters) above plant grade, and the direction looking at a given source from a given receptor in degrees relative to True North.

Enclosures 9, 10, and 11 also included 32 ARCON96-NAI model runs (again, one input and two output files per run) to evaluate various accident release scenarios from the reactor building vent and the RWST vent as potential sources. The control room operator access path was sketched on Figure 3.2 of Enclosure 1. Receptor locations are presumably at the turning points along this sketched path.

Figure 3.1 of Enclosure 1 indicates the offset between Plant North and True North (i.e., the former is oriented about 133.56 degrees counterclockwise of the latter). Neither Figure 3.1 nor Figure 3.2 of Enclosure 1 indicates a distance scale as called for by Question 17a from the previously referenced pre-application meetings with the Licensee.

RAI-2a

The NRC staff tried to verify many of the distances between the numerous potential source and receptor pairs as well as the receptor-to-source directions of these pairs relative to True North using Table 3-25 and Figure 3.1 of Enclosure 1 to the supplementary submittal and other readily available information. In doing so, the staff exercised reasonable flexibility, given this information, by considering distances to be verified if they were within about ± 5 meters and about ± 5 degrees relative to True North of the values listed in Table 3-25.

The items listed in Figure 3.1 use phrases such as “nearest point to receptor”, “closest [source name]”, and “closest [source name] nearest point to receptor”. However, when evaluating a number of the same sources but impacting a different receptor, the distance and/or receptor-to-source direction would only meet the above acceptance criteria if the source and/or receptor were located in different positions (e.g., at some point on the item label itself, at the tip of the arrow associated with an item label, at some point on the edge of the building housing a potential source or receptor, or at some point within the perimeter of the building itself).

As a result, this portion of the ARCON96-NAI dispersion modeling review was not completed. Because these characteristics are direct inputs to the run files, Figure 3.1 in Enclosure 1 of the supplemental submittal should be clarified: (a) to include a distance scale, and (b) show specific source and receptor locations that correspond to the various model runs. Due to the number of model-runs, more than one figure may be necessary to clearly illustrate all of these relationships. Any other figures, tables, and text affected by these clarifications should be revised as well.

RAI-2b

Figure 3.2 in Enclosure 1 of the supplemental submittal should be: (a) clarified to include a distance scale, (b) ensure that its orientation, as reproduced in that submittal, is relative to Plant North, (c) identify the potential release points for the reactor building vent and RWST vent, and (d) indicate the receptor locations evaluated in the corresponding model runs (e.g., presumably at the turning points along the sketched path in Figure 3.2). As above, any other figures, tables, and text affected by these clarifications should be revised as well.

RAI-2c

Clearly explain the purpose and use of the thirteen (13) ARCON96-NAI model runs provided in Enclosures 9, 10, and 11 of the supplemental submittal with receptor distances ranging between 1322.7 m and 1471.7 m. This includes verifying: (a) what the distances entered in the input files are relative to (e.g., the EAB), (b) what directions relative to True North the respective distances correspond to understanding that the distances selected may not necessarily be associated with the directions having the most restrictive dispersion conditions (i.e., the highest X/Qs), (c) what potential source each run corresponds to (only a few appear to be missing), and (d) their relationship, if any, to the offsite model runs using PAVAN-NAI.

OPERATOR LICENSING AND HUMAN FACTORS BRANCH RAI

REGULATORY BASIS

10 CFR Part 50.67(b) states, in part, that "[a] licensee who seeks to revise its current accident source term in design basis radiological consequence analyses shall apply for a license amendment under § 50.90. The application shall contain an evaluation of the consequences of applicable design basis accidents previously analyzed in the safety analysis report."

NUREG-0800, Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms," Rev. 0, assigns responsibility to the Operator Licensing and Human Factors Branch for the review issues related to emergency operating procedures and human factors engineering design. This section also states, in part, that an acceptable implementation of an alternative source term should demonstrate compliance with plant-specific licensing commitments made in response to the NUREG-0737, "Clarification of TMI Action Plan Requirements." Specific provisions of interest within the context of this review plan section include III.D.3.4, Control Room Habitability, as it relates to maintaining the control room in a safe, habitable condition under accident conditions by providing adequate protection against radiation and toxic gases.

BACKGROUND INFORMATION:

In the license amendment, Callaway does not appear to address the area of emergency operating procedures. In order to determine whether human factors considerations have been adequately accounted for, the NRC staff require a description of whether modifications to emergency operating procedures will occur as part of the LAR (for example: the incorporation of new or modified operator actions for maintaining control room habitability under accident conditions).

RAI HFE #1

Please describe whether Callaway will be modifying any emergency operating procedures as part of the LAR and, if so, describe the procedural changes, any changes in the time constraints associated with the performance of procedurally driven actions, and any operator training associated with those changes. If applicable, be sure to include a discussion of how the considerations like those in NUREG-0737 described above are addressed.

MECHANICAL AND INSERVICE TESTING BRANCH RAI

REGULATORY BASIS

RG 1.183, Re-Analysis Guidance section identifies that the ability of the damper to close against increased containment pressure may need to be evaluated or the ability of ductwork downstream of the dampers to withstand increased stresses.

BACKGROUND INFORMATION:

In Enclosure 1, Section 2.2.2 of the LAR, the licensee addresses Control Room Emergency Ventilation System (CREVS) Design and Operation. However, the following information was not discussed, and the licensee is requested to provide details.

EMIB-RAI-1:

The licensee is requested to provide the following details:

a) Discuss whether the adoption of the Alternative Source Term (AST) affects any of the safety related piping.
b) Discuss whether any safety related Heating Ventilation and Air Conditioning (HVAC) system is credited in the AST adoption.
c) Discuss the seismic qualification of the control room safety related HVAC including ductwork, air handlers, damper systems, chillers, and supports.