UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 29, 2014

Mr. Fadi Diya
Senior Vice President and
Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 – REQUEST FOR ADDITIONAL INFORMATION RE: CALLAWAY FLOODING HAZARD REEVALUATION REPORT (TAC NO. MF1096)

Dear Mr. Diya:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a Request for Information pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 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, to all power reactor licensees and holders of construction permits in active or deferred status. By letter dated March 8, 2013, Union Electric Company, d/b/a Ameren Missouri (the licensee), submitted the "Callaway Energy Center Unit 1 Flooding Hazard Reevaluation Report," dated February 6, 2013, for Callaway Plant, Unit 1.

The NRC staff has determined that additional information, as requested in the enclosure, is needed to complete its review of your Flooding Hazard Reevaluation Report for Recommendation 2.1. Please provide a response to the questions within 30 days of the date of this letter.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for NRC staff review and contribute toward the NRC's goal of efficient and effective use of NRC staff resources. If circumstances result in the need to revise the requested response date, please contact me at 301-415-2296 or via e-mail at Fred.Lyon@nrc.gov.

Sincerely,

CFLyon

Carl F. Lyon, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:
Request for Additional Information

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFORMATION

FLOODING HAZARD REEVALUATION REPORT

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a "Request for Information pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 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" (the 50.54(f) letter, available in the Agencywide Documents Access and Management System (ADAMS) at Accession No. ML12053A340), to all power reactor licensees and holders of construction permits in active or deferred status. By letter dated March 8, 2013 (ADAMS Accession No. ML13071A315), Union Electric Company, d/b/a Ameren Missouri (the licensee), submitted the "Callaway Energy Center Unit 1 Flooding Hazard Reevaluation Report," dated February 6, 2013 (the FHRR, which is publicly available in ADAMS Package Accession No. ML130710492), for Callaway Plant, Unit 1

The NRC staff has determined that additional information, as requested below, is needed to complete its review.

RAI 1: Local Intense Precipitation Flooding

In order to review the evaluation of local intense precipitation (LIP), the NRC staff requests additional information regarding the HEC-HMS subbasins shown in FHRR Figure 3-3. Specifically, please provide: (a) discussion of the delineation of subbasins for the LIP evaluation, (b) electronic versions of digital elevation models, (c) input and output files from the application of ArcHydro, and (d) ArcGIS shapefiles used in modeling of LIP. Please also provide electronic versions of the HEC-HMS input files for all scenario runs.

RAI 2: Local Intense Precipitation Flooding

Please provide a digital image showing the subbasin delineation overlaid on a satellite (or airphoto) image of the site or a plant layout map. For example, a similar image is provided in the NRC Library as part of Figure 2-1 from Rizzo calculation package 12-4939 F-02.

RAI 3: Local Intense Precipitation Flooding

Please provide justification, based on a sensitivity analysis, of whether or not the 6-hr probable maximum precipitation (PMP) scenario used in the LIP analyses bounds the effects of LIP in comparison with alternative duration PMP scenarios, such as 12-hr, 48-hr, and 72-hr PMP values. The bounding LIP scenario(s) should be determined based on the severity of the flood level as well as the inundation duration. Please describe the rationale for evaluating LIP using a temporal rainfall distribution in which the peak rainfall intensity occurs at the beginning of the

PMP event and decreases thereafter. In addition, please describe which rainfall distribution results in the larger water height at the site.

RAI 4: Local Intense Precipitation Flooding

Please state the time step of the incremental PMP (for example, 5 minutes), along with a justification for its use, associated with modeling the runoff generation from the PMP event discussed in FHRR Section 3.2.1.1 (esp. Figure 3-2). Also, please provide a sensitivity analysis of the selected time step.

RAI 5: Local Intense Precipitation Flooding

(1) Please provide the following information related to the HEC-HMS LIP flood modeling discussed in the FHRR Section 3.2.1.3:

- Description of the "quasi-steady-state" approach stated in the calculation package F-03 for determining LIP flood elevations.
- Discussion of the approaches to delineate overland flow pathways within the site, and assumptions in routing of flow between HEC-HMS subbasins.
- Description of the basis for assigning HEC-HMS parameter values, such as the weir coefficient and Manning's roughness coefficient.

(2) Please clarify the following inconsistencies related to the HEC-HMS LIP flood modeling:

- The FHRR states (on page 13) that time of concentration was used to calculate lag time, but calculation package F-03 indicates that the lag time was calculated from subbasin parameters and was used to estimate time of concentration.
- The FHRR and the calculation packages contain two different descriptions of LIP Scenario 1. FHRR Section 3.2.1.2 and calculation package F-02 describe a Scenario 1 that included calculation of runoff using the Rational Runoff Transformation Method, while FHRR Section 3.2.1.3 and calculation package F-03 indicate that HEC-HMS output was used in the evaluation of flood elevations for Scenario 1.

RAI 6: Local Intense Precipitation Flooding

Please provide the electronic version of the HEC-RAS input files, including the HEC-GeoRAS files, related to the local intense precipitation flood analyses.

RAI 7: Local Intense Precipitation Flooding

Information provided in calculation package F-03 indicates that the "mean sea level" (MSL) datum used in the current design basis at the Callaway Energy Center site apparently is based on NGVD 29, while NAVD 88 is the datum for the new HEC-RAS analysis. The calculation package states that it is conservative to treat NAVD 88 and MSL as equivalent, but the package

does not explain why this is conservative. Please clarify the basis for concluding that this equivalency is a conservative assumption.

RAI 8: Local Intense Precipitation Flooding

In order to evaluate the licensee's analysis of water elevations resulting from LIP, the NRC staff needs additional information on the licensee's determination of the Manning's n roughness coefficient. Please provide descriptions of the terrain conditions of areas where overland flow would occur and the rationale for selecting a value (or values) for Manning's n roughness coefficient for these areas.

RAI 9: Local Intense Precipitation Flooding

Please provide a description of how the Vehicle Barrier System (VBS) was treated in the licensee's LIP model(s). The FHRR states that the VBS location affected the delineation of subbasin boundaries for modeling of LIP and that the most conservative simulation (Scenario 1) treated openings in the VBS as blocked, while the other scenarios represented these openings as open to flow. Calculation package F-03, provided in the NRC Library, contains an image showing the locations of closed and open VBS barrier openings and it contains a table listing the dimensions of the openings, but the image resolution is too low for interpretation and the identifiers in the table are not referenced to the figure.

RAI 10: Local Intense Precipitation Flooding

For the LIP Scenarios 2 through 5 described in the FHRR Section 3.2.1.2, please provide an explanation of why the modification to the conservative assumptions (e.g., assumptions regarding the state of the VBS and values of runoff coefficients required by the Snyder Runoff Transformation Method) made in the low-order LIP scenario (e.g., Scenario 2 versus Scenario 3, and so on) provides a conservative assessment. Additionally, provide a description of the basis for selecting the Snyder Runoff Transformation Method to perform runoff transformations in Scenarios 3 through 6, and describe whether this method provides a conservative assessment of the effects of local intense precipitation on this site.

RAI 11: Local Intense Precipitation Flooding

Results associated with the LIP flood modeling presented in the NRC Library indicate that the HEC-HMS model reported error messages for some subbasins for Scenario 5. Please provide a description of the effects of the reported errors on model results, and either a justification to demonstrate the acceptability of the model results for LIP Scenario 5, or a reanalysis that does not have errors.

RAI 12: Local Intense Precipitation Flooding

The FHRR Section 3.2.1.4 states that areas of ponding other than the ultimate heat sink (UHS) retention pond have insufficient fetch distances to generate wind-wave activity with the potential to affect structures, systems, and components. This rationale is not sufficient to explain the reason for not considering potential wind-wave activity for subbasin 22. FHRR Figures 3-3 and 3-4 shows that subbasin 22 has a larger maximum dimension (and, thus, could be expected to

have a larger fetch distance) than the UHS retention pond, as well as a higher LIP-associated water level. Please provide either a reanalysis of LIP flooding with wind effects or the rationale for not considering the wind effects from subbasin 22.

RAI 13: Need for the Integrated Assessment

Please confirm whether or not an integrated assessment will be submitted within 2 years of the submittal of the FHRR. Also, clarify which flood hazard mechanisms will be included in the Integrated Assessment, if applicable.

RAI 14: Hazard Input for the Integrated Assessment

Enclosure 2 of the NRC's 50.54(f) letter dated March 12, 2012, 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. Flood scenario parameters from the flood hazard reevaluation serve as the input to the integrated assessment. To support efficient and effective evaluations under the integrated assessment, the NRC staff will review flood scenario parameters as part of the flood hazard reevaluation and document results of the review as part of the staff assessment of the flood hazard reevaluation.

If an integrated assessment will be performed (see RAI 13 above), then please provide the applicable flood event duration parameters (see definition and Figure 6 of the Guidance for Performing an Integrated Assessment, JLD-ISG-2012-05) associated with mechanisms that trigger an integrated assessment using the results of the flood hazard reevaluation. 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. Also, please 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 15: Hazard Input for the Integrated Assessment

Enclosure 2 of the NRC's 50.54(f) letter dated March 12, 2012, 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. Flood scenario parameters from the flood hazard reevaluation serve as the input to the integrated assessment. To support efficient and effective evaluations under the integrated assessment, the NRC staff will review flood scenario parameters as part of the flood hazard reevaluation and document the results of the review as part of the staff assessment of the flood hazard reevaluation.

If an integrated assessment will be performed (see RAI 13 above), please provide a summary of the flood height and associated effects (as defined in Section 9 of JLD-ISG-2012-05) for mechanisms that trigger an Integrated Assessment. This includes the following quantified information for each mechanism, as applicable:

- Flood height
- Wind waves and run-up,
- Hydrodynamic loading, including debris,
- Effects caused by sediment deposition and erosion (e.g., flow velocities, scour),
- Concurrent site conditions, including adverse weather,
- Groundwater ingress, and
- Other pertinent factors.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for NRC staff review and contribute toward the NRC's goal of efficient and effective use of NRC staff resources. If circumstances result in the need to revise the requested response date, please contact me at 301-415-2296 or via e-mail at Fred.Lyon@nrc.gov.

Sincerely,

/RA/

Carl F. Lyon, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:
Request for Additional Information

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ADAMS Accession No.: ML14028A264 *email dated January 27, 2014

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