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0CAN091401

September 9, 2014

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

SUBJECT: Data Request Supporting United States Army Corps of Engineers (USACE) Flood Analysis
Arkansas Nuclear One – Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6

REFERENCES:

1. NRC Letter, Request for Information (RFI) Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-Ichi Accident; dated March 12, 2012, (0CNA031208) (ML12073A348)
2. Entergy letter to NRC, Entergy's Response to NRC RFI Pursuant to 10 CFR 50.54(f) Regarding the Flooding Aspects of Recommendations 2.1 and 2.3 of the NTTF Review of Insights from the Fukushima Dai-ichi Accident, dated June 8, 2012 (0CAN061202) (ML12164A567)
3. Entergy letter to NRC, Assistance in Obtaining Information on Dams, dated September 30, 2013 (0CAN091302) (ML13275A067)
4. NRC Letter, Arkansas Nuclear One Units 1 and 2- Relaxation of Response Due Date Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the NTTF Review of the Insights from the Fukushima Dai-Ichi Accident, dated July 17, 2014 (0CNA071402) (ML14171A529)

Dear Sir or Madam:

On March 12, 2012, the NRC issued Reference 1 requesting information pursuant to Title 10 of the Code of Federal Regulations 50.54(f). Enclosure 2 of that letter contained specific requested Information associated with NTTF Recommendation 2.1 for flooding. By Reference 2 Entergy Operations, Inc. (Entergy) committed to submit the flood hazard reevaluation report (FHRR) for Arkansas Nuclear One (ANO), Units 1 and 2 as a Category 2 site by March 12, 2014.

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NRR

In September 2013 (Reference 3), Entergy requested the assistance of the NRC to obtain information from three Districts of the USACE to support the FHRR at ANO. In July 2014 (Reference 4), NRC approved a revised schedule for submittal of the ANO FHRR following receipt of USACE analysis.

This letter is voluntary submitting information to assist the NRC and the USACE in performing the analysis requested by Reference 3. Entergy believes this information will be useful and requests the expeditious completion of the USACE analysis.

The enclosure to this letter is a hard drive containing files for the four calculations supporting the ANO flood hazard reevaluation. The hard drive components (files/folders) are listed in the index file; the index file name is 'ANO calculation electronic file list 8-26-14.txt.' The attachment to this letter provides a summary description of the calculations.

This letter contains no new regulatory commitments. Should you have any questions regarding this submittal, please contact Stephenie Pyle at 479.858.4704.

Sincerely,

SLP/nbm

Attachment: Arkansas Nuclear One (ANO) Units 1 and 2 (ANO-1 and ANO-2) Summary Description of Flooding Calculations

Enclosure: Hard drive with electronic information

cc: Mr. Marc L. Dapas (w/o enclosure)
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Attachment to

0CAN091401

Arkansas Nuclear One (ANO) Units 1 and 2 (ANO-1 and ANO-2) Summary Description of Flooding Calculations

Arkansas Nuclear One (ANO) Units 1 and 2 (ANO-1 and ANO-2) Summary Description of Flooding Calculations

Probable Maximum Precipitation

Summary:

The purpose of this calculation is to establish the Probable Maximum Precipitation (PMP) at Arkansas Nuclear One (ANO), both at the site and its upstream Arkansas River watershed. A site-specific PMP study was conducted for the Arkansas River watershed near ANO because the contributory watershed (over 150,000 square miles) exceeds the watershed area upper limit of 20,000 square miles in Hydrometeorological Reports 51 and 52. The results on the site-specific PMP study are that the maximum storm duration is 72 hours and the maximum storm size is 100,000 square miles. The 100,000 square mile PMP does not cover the entire watershed but is the largest storm considered physically possible due to meteorological limitations on storm duration, size, and orientation. The average PMP rainfall depth for the portion of the watershed covered by the 100,000 square mile, 72-hour PMP centered at the watershed centroid is 7.7 inches. A higher average PMP rainfall depth of 10.2 inches for the 72-hour duration occurs with the PMP centered at the centroid of the Robert Kerr subwatershed.

Calculations and Computer Models:

Detailed report describing site-specific PMP study, storm analyses, procedures, and results.

Geographic Information Systems (GIS) shapefiles for:

- Depth-area-duration output
- Storm center locations
- Storm isohyets

Microsoft Excel spreadsheets applying depth-area-duration information to the watershed as per HMR-52 application guidance.

Probable Maximum Flood – Hydrology

Summary:

The purpose of this calculation is to develop the Probable Maximum Flood (PMF) hydrograph resulting from the application of the PMP to the Arkansas River watershed contributory to ANO. The large watershed was divided into 22 subwatersheds. A calibrated and verified Hydrologic Engineering Center (HEC) – Hydrologic Modeling System rainfall-runoff model was developed for the watershed. Snyder unit hydrograph methodology and Muskingum (or Muskingum-Cunge) river routing was used. The Snyder and Muskingum (or Muskingum-Cunge) parameters for each subwatershed were calibrated using three floods and verified used three (separate) floods. Non-linearity adjustments were included for the PMF simulations as per recommendations in NUREG/CR-7046.

Calculations and Computer Models:

GIS shapefiles for:
- Watershed and subwatershed delineation
- Preliminary subwatershed constant loss values
- Initial subwatershed lag time
- Thiessen polygons for weighting precipitation

Multiple HEC-HMS files for:
- Calibration floods
- Verification floods
- PMF candidate storms (five scenarios)
- Non-linearity adjustments for the PMF candidate storms

Probable Maximum Flood – Hydraulics

Summary:

The purpose of this calculation is to establish the water surface elevation resulting from the PMF on the Arkansas River near Arkansas Nuclear One. A HEC-RAS computer model (unsteady) was developed for a 117-mile long reach of the Arkansas River, from upstream of Trimble Lock and Dam No. 13 to downstream of the Arthur V. Ormond Lock and Dam No. 9, respectively. The Arkansas State Highway Route 109 Bridge and the Dardanelle Bridge were incorporated into the model. The HEC – River Analysis System (RAS) model was calibrated using the flood of record (May 1990).

Calculations and Computer Models:

GIS shapefiles for:
- Cross-section locations

Drawings for the bridges incorporated into HEC-RAS

Multiple HEC-RAS files for:
- Calibration flood
- PMF candidate storms (five scenarios) adjusted for non-linearity

Dam Failures

Below is the list of individually modeled dam failures:

Dam Name	National Inventory Identifier
Birch Lake	OK20508
Eufaula Lake	OK10308
Fort Gibson Lake	OK10314
Heyburn Lake	OK10313
Hilbert Klinger	OK22217
James W. Trimble Lock and Dam	AR00163
Kaw Lake	OK20509
Keystone Lake	OK10309
Lake Fort Smith Dam	AR00446
Lee Creek	AR01492
Oologah Lake	OK10310
Pensacola	OK00135
Robert S. Kerr	OK00134
Robert S. Kerr Lock and Dam	OK10301
Skiatook Lake	OK22200
Tenkiller Lake	OK10311
Tulsa River Parks	OK21620
W.D. Mayo Lock and Dam	OK10305
Webbers Falls Lock and Dam	OK10304

Summary:

The purpose of this calculation is to assess the effect of upstream dam failures on the maximum water surface elevation of the Arkansas River near ANO. Three dam failure scenarios were evaluated: 1) Hydrologic dam failure, coincident with the PMF, 2) Seismic dam failure, coincident with a 500-year flood and 3) Sunny-day dam failure, coincident with a typical base flow. The dams within each subwatershed were "combined" and modeled as hypothetical dams located at the most downstream point of each subwatershed. The peak breach outflow for the hypothetical dams was estimated using Froehlich regression equation. Peak breach outflow for each hypothetical dam was attenuated using the United States Bureau of Reclamation (USBR) attenuation equation. Peak dam breach outflow from individual dams (not included in the hypothetical dams) was calculated using HEC-HMS and calibrated based on the results of a sensitivity analysis using the Froehlich regression equations. Breach parameters

were selected based on Federal Energy Regulatory Commission guidance. The most severe PMF scenarios were evaluated to determine the controlling combined dam breach and PMF flow at ANO using HEC-HMS. The peak water surface elevation resulting from the combination of upstream dam breach and the PMF at ANO was calculated using HEC-RAS.

Calculations and Computer Models:

GIS shapefiles for:
- Dam locations
- Hypothetical dam locations

Multiple HEC-HMS files for the three dam failure scenarios:
- Peak breach outflow for hypothetical dams
- Peak breach outflow for individually modeled dams
- Combining upstream dam breach and the PMF flows

Multiple HEC-RAS files for:
- Combining upstream dam breach and the PMF flows for the three dam failure scenarios

Microsoft Excel spreadsheets for calculating hypothetical dam properties, calculating peak breach outflows using Froehlich regression equations and calculating attenuated peak breach outflow using the USBR attenuation equations.