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1CAN062201 10 CFR 50.90

June 2, 2022

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Response to the Request for Additional Information
Proposed Technical Specifications 3.4.12 and 3.4.13
Revised Dose Calculations

Arkansas Nuclear One, Unit 1
NRC Docket No. 50-313
Renewed Facility Operating License No. DPR-51

References:

1) Entergy Operations, Inc. (Entergy) letter to the U. S. Nuclear Regulatory Commission (NRC), "License Amendment Request Proposed Technical Specifications 3.4.12 and 3.4.13 Revised Dose Calculations", (1CAN092101) (ADAMS Accession No. ML21274A874), dated September 30, 2021

2) NRC email to Riley Keele (Entergy), "Final RAI RE: License Amendment Requests Concerning TS Change Due to Revised Dose Calculations (L-2021-LLA-0181)," (1CNA042201), (ADAMS Accession No. ML22108A164), dated April 18, 2022

By Reference 1, Entergy Operations, Inc., (Entergy) requested the U.S. Nuclear Regulatory Commission (NRC) to approve a license amendment for Arkansas Nuclear One, Unit 1 (ANO-1). The requested amendment would revise the Dose Equivalent Iodine (I)-131 and the reactor coolant system (RCS) primary activity limits required by Technical Specification (TS) 3.4.12, “RCS Specific Activity”. In addition, a new primary-to-secondary leak rate limit, provided in TS 3.4.13, “RCS Leakage”, is being proposed. These proposed changes are due to non-conservative inputs used in the Steam Generator Tube Rupture (SGTR) accident, the Main Steam Line Break (MSLB) accident, and the Control Rod Ejection accident dose calculations.

This letter contains proprietary information.
Withhold Enclosure 1 from public disclosure in accordance with 10 CFR 2.390.

From January 31, 2022, through March 11, 2022, the NRC staff conducted a virtual regulatory audit of the licensee's calculations and analyses supporting the proposed license amendment.

The NRC staff has reviewed the application and determined that additional information was required (Reference 2).

The Requests for Additional Information (RAIs) and the associated responses are provided in Enclosure 1.

Some information provided in Enclosure 1 is considered proprietary to MPR Associate, Inc. and request it to be withheld from public disclosure in accordance with 10 CFR 2.390 of the Commission's regulations. The proprietary information is identified by text enclosed within double brackets [[Example]]. The non-proprietary version is provided in Enclosure 2.

This information is supported by an affidavit, signed by MPR Associate, Inc., the owner of the information. The affidavit sets forth the basis by which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390 of the Commission's regulations. The affidavit is included in Enclosure 3.

The responses to the RAIs do not affect the no significant hazards consideration provided in Reference 1.

There are no new regulatory commitments established in this submittal.

If there are any questions or if additional information is needed, please contact Riley Keele, Manager, Regulatory Assurance, Arkansas Nuclear One, at 479-858-7826.

I declare under penalty of perjury; that the foregoing is true and correct.
Executed on June 2, 2022.

Respectfully,

Stephenie Pyle

Digitally signed by Stephenie Pyle
DN: cn=Stephenie Pyle, c=US, o=Entergy, ou=Fleet Compliance Director, Regulatory Assurance, email=spyle@entergy.com
Date: 2022.06.02 14:30:38 -05'00'

Stephenie Pyle

SLP/rwc

Enclosure:
1. Response to Request for Additional Information (**PROPRIETARY)**
2. Response to Request for Additional Information (**NON-PROPRIETARY)**
3. Affidavit

cc: NRC Region IV Regional Administrator
NRC Senior Resident Inspector – Arkansas Nuclear One
NRC Project Manager – Arkansas Nuclear One
Designated Arkansas State Official

ENCLOSURE 2

1CAN062201

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

(NON-PROPRIETARY)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

By Reference 1, Entergy Operations, Inc., (Entergy) requested the U.S. Nuclear Regulatory Commission (NRC) to approve a license amendment for Arkansas Nuclear One, Unit 1 (ANO-1). The requested amendment would revise the Dose Equivalent Iodine (I)-131 and the reactor coolant system (RCS) primary activity limits required by Technical Specification (TS) 3.4.12, "RCS Specific Activity". In addition, a new primary-to-secondary leak rate limit, provided in TS 3.4.13, "RCS Leakage", is being proposed. These proposed changes are due to non-conservative inputs used in the steam generator tube rupture (SGTR) accident, the main steam line break accident, and the control rod ejection accident dose calculations.

From January 31, 2022, through March 11, 2022, the NRC staff conducted a virtual regulatory audit of the licensee's calculations and analyses supporting the proposed license amendment.

The NRC staff has reviewed the application and determined that additional information was required (Reference 2).

Below are the Requests for Additional Information (RAIs) and the associated responses.

Nuclear Systems Performance Branch (SNSB) SNSB-RAI-1

The Steam Generator Tube Rupture (SGTR) break flow flashing fraction was determined using data from the SGTR case with delayed reactor trip. However, the dose calculations use the SGTR case with an early reactor trip. The NRC staff requests the licensee to:

a. Provide justification as to why the calculated flashing fraction is applicable for both early and delayed reactor trip cases, or

b. Recalculate the flashing fraction based on data from the early reactor trip case.

<u>Entergy's Response to SNSB-RAI-1</u>

Entergy addressed this RAI by following Option b. above. The flashing fraction calculation has been revised to include flashing fraction calculation for both the delayed and early reactor trip cases. The dose calculations use the flashing fractions that bound both the delayed and early reactor trip scenarios.

Although the early and late scram cases see similar trends, the early scram case took slightly longer for the vaporization fraction to drop off than the delayed case. This behavior necessitated a small change to the SGTR dose analysis to bound the observed thermal-hydraulics data. Instead of assuming the vaporization rate drops to 40% at 14 minutes (840 seconds), the dose analysis was re-evaluated assuming an intermediate drop to 65% at

645 seconds and then a drop to 40% at 1080 seconds where it remains until the ruptured generator is isolated. The bounding vaporization fraction is illustrated in the figure below for the original and revised dose analyses.

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The earlier credit for a flashing fraction less than 100% resulted in negligible reduction on the calculated offsite SGTR doses and a small decrease in the control room dose. The Reactor Coolant System (RCS) iodine and alkali metal RADTRAD runs are the only runs affected. Since the RCS noble gas model already applies a 100% vaporization for the entire release, it is unaffected by this change other than negligible impacts in the fourth significant figure due to the addition of the new time interval. The Main Steam Line Break and Control Rod Ejection calculations are unaffected since this change only affects the SGTR tube rupture flow. The original and updated SGTR doses are listed in the table below.

SGTR Case	Original (Rem TEDE)			Updated (Rem TEDE)		
	Exclusion Area Boundary	Low Population Zone	Control Room	Exclusion Area Boundary	Low Population Zone	Control Room
Pre-Existing Spike	1.81	0.29	4.92	1.79	0.29	3.68
Accident-Induced Spike	2.45	0.41	2.76	2.45	0.41	2.31

SNSB-RAI-2

During the regulatory audit, NRC staff reviewed the calculations of the SGTR break flow flashing fraction and discovered that the steam generator (SG) steam flow data used was significantly lower than the nominal steam flow. Since the case was run from full power, the NRC staff requests the licensee to:

a. Confirm that the correct steam flow data was used, and

b. If the correct steam flow data was used, justify why this is significantly lower than the nominal steam flow, or

c. If the steam flow data was incorrect, repeat the calculations and provide updated results for the flashing fraction.

<u>Entergy's Response to SNSB-RAI-2</u>

The flashing fraction calculation has been revised (Option c. above) to use the total steam flow for an Enhanced Once Through Steam Generator (EOTSG) for both the delayed and early reactor trip scenarios. A copy of the revised calculation is in the portal that was established for this purpose.

SNSB-RAI-3

During the audit, the NRC staff determined that the computational fluid dynamics (CFD) analysis did not contain sufficient validation, verification, and uncertainty analyses using experimental data obtained from a geometry like a steam generator or a scaled model capturing the complexities of the two-phase flow jet in a tube bundle. Therefore, NRC staff is treating the results of the Computational Fluid Dynamics (CFD) analysis as input assumptions to the other calculations. The NRC staff requests that the licensee provide justification that the number of wetted tubes (650 above tube support plate (TSP) #15 and 180 below TSP #15) and the wetted surface area of the tube sheet are conservative. The discussion should include information

related to how much of the break flow is converted into steam from each method of heat transfer (i.e., from the tubes, from the tube sheet, etc.).

Entergy's Response to SNSB-RAI-3

The CFD calculation determines the zone of influence (ZOI) that contains the EOTSG tubes and downward facing surface of the upper tube sheet that could be wetted by the break flow from a ruptured tube. The CFD calculation utilizes several conservative assumptions to maximize the ZOI that surrounds the wetted EOTSG tubes and downward facing surface of the upper tube sheet. **[[**

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The flashing or evaporation of the break flow from a ruptured tube is determined in the flashing fraction calculation. **[[**

]] The conservative assumptions used in flashing fraction calculation ensure that the heat transfer from the fluid in the primary side to the rupture flow dispersed in the EOTSG secondary side and the corresponding steam generation rate are consistently overestimated. As a result, the calculated steam generation capacity **[[**

]] are conservatively calculated. The steam generation capacity for **[[**

.

]]

Figure 5 shows the total steam generation capacity for both the delayed and early reactor trip scenarios. **[[**

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The relative contribution from each mechanism for steam generation is shown in Figure 6 and Figure 7 as a percentage of the total steam generation for the delayed and early reactor trip scenarios, respectively. **[[**

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SNSB-RAI-4

The calculations of evaporation due to heat transfer from the SG tubes includes convective heat transfer at the tube inner surface and nucleate boiling on the tube outer surface. The NRC staff requests that the licensee provide the heat transfer correlations used in these calculations and justification that they are appropriate for the applicable geometry.

Entergy's Response to SNSB-RAI-4

Heat transfer from the primary fluid to the liquid film on the outer surfaces of wetted tubes results in evaporation of the liquid film. This is one of the mechanisms for steam generation described in the flashing fraction calculation and briefly discussed in response to the SNSB-RAI-3. The rate of heat transfer from the primary flow to the liquid film originated from the rupture flow accounts for the following effects in series:

1. Convective heat transfer at the tube inner diameter,

2. Conductive heat transfer across the tube wall thickness, and

3. [[ ]] at the tube outer diameter.

[[

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Convective heat transfer at the tube ID

[[

]]

[[ ]] heat transfer at the tube OD

Heat is transferred from the outer surface of the EOTSG tube to the fluid film formed on the tube outer surface. **[[**

]] As a general principle, the heat transfer takes the path of the least resistance, which corresponds to the transfer with the highest transfer coefficient. **[[**

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SNSB-RAI-5

The calculations for evaporation due to heat transfer from the SG tube sheet and evaporation due to heat transfer from superheated steam flow are not described in the license amendment request (LAR). The NRC staff requests that the licensee describe these calculations. The response should include details concerning any heat transfer correlations used and why they are appropriate for the applicable geometry.

Entergy's Response to SNSB-RAI-5

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Operator Licensing and Human Factors Branch (IOLB) IOLB-RAI-1

The regulation in 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 NRC’s 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 [Three Mile Island] 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.

1. In the license amendment request (LAR) dated September 30, 2021, the licensee does not appear to directly address the area of emergency operating procedures.

   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 (such as, for example, the incorporation of new or modified operator actions for maintaining control room habitability under accident conditions). In the no significant hazards consideration analysis, the licensee responded in part, as follows:

   > Does the proposed amendment create the possibility of a new or different kind of accident from any previously evaluated?
   >
   > Response: No
   >
   > The proposed amendment changes accident analysis inputs for calculating dose consequences at the EAB [exclusion area boundary], LPZ [low population zone], and CR [control room]. There are no plant modifications or operating procedure changes.

   Confirm that the licensee will not be modifying any emergency operating procedures as part of the LAR. If modifications are proposed, 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, include a discussion of how the considerations like those in NUREG-0737 described above are addressed.

<u>Entergy’s Response to IOLB-RAI-1 1</u>

There are no substantive changes required to the ANO-1 Emergency Operating Procedures due to this LAR. Any changes made will be minor in nature, for clarification.

2. The credited manual actions are described in the technical evaluation portion of the LAR in the thermal-hydraulic model, which affects only the SGTR. It is the NRC staff's understanding that the actions described are no different than those that are currently credited. Confirm that there are no changes to operator actions and that the current operator actions will not be impacted by the revised thermal-hydraulic model changes. If changes are required, provide the details of the changes.

Entergy's Response to IOLB-RAI-1 2

The manual actions credited in the thermal-hydraulic model for the SGTR analysis credit existing manual actions. The current operator actions required to respond to a steam generator tube rupture will not be changed by the LAR.

REFERENCES

1) Entergy Operations, Inc. (Entergy) letter to the U. S. Nuclear Regulatory Commission (NRC), "License Amendment Request Proposed Technical Specifications 3.4.12 and 3.4.13 Revised Dose Calculations", (1CAN092101) (ADAMS Accession No. ML21274A874), dated September 30, 2021

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ENCLOSURE 3

1CAN062201

AFFIDAVIT

(2 Pages)

MPR

May 27, 2022

AFFIDAVIT

I, John W. Simons, state and affirm as follows:

(1) I am the Vice President of Power Services at MPR Associates, Inc. (MPR) and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld from public disclosure and have been authorized to apply for its withholding.

(2) The request for withholding of proprietary information is made in accordance with 10 CFR 2.390. The information sought to be withheld is contained in Response to the Request for Additional Information – Proposed Technical Specifications 3.4.12 and 3.4.13 Revised Dose Calculations, Arkansas Nuclear One, Unit 1 Docket No. 50-313.

The document is to be treated as MPR proprietary information because it contains information which has a commercial value to MPR.

- The responses include details of an analysis methodology that MPR developed. The details of the analysis methodology were developed based on extensive research and deliberations among MPR personnel and reflect the combined technical expertise and insights of MPR. Public release of the information would concede intellectual property and a commercial advantage to others pursuing similar analysis methodology and/or technical services.

- The responses include excerpts from the analysis that MPR performed using this methodology. Public release of the information would concede intellectual property and a commercial advantage to others engaged in evaluation of the flashing fraction calculation during a steam generator tube rupture event.

(3) The information for which withholding from disclosure is requested qualifies under 10 CFR 2.390(a)(4) "Trade secrets and commercial or financial information."

(4) The material for which exemption from disclosure is herein sought is considered proprietary for the following reasons:

a) Use of the information by a competitor would permit the competitor to significantly reduce its expenditures, in time or resources, to design, produce, or market a similar product or service.

b) The information is vital to a competitive advantage, would be helpful to competitors and would likely cause substantial harm to the competitive position.

(5) Public disclosure of the information sought to be withheld is likely to cause substantial harm to MPR.

(6) The foregoing statements are true and correct to the best of my knowledge, information, and belief.

John W. Simon

Vice President

SUBSCRIBED before me this 27th day of May 2022

Nancy Gail Svites [NOTARY]

NANCY GAIL SVITES
NOTARY PUBLIC
REG. #7261343
MY COMMISSION EXPIRES
02/28/2025
COMMONWEALTH OF VIRGINIA

Nancy Gail Svites
NOTARY PUBLIC
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COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES FEBRUARY 28, 2025