

**From:** Wengert, Thomas  
**Sent:** Friday, January 10, 2020 7:52 AM  
**To:** Arnold, Timothy  
**Cc:** BICE, DAVID B (ANO); Dixon-Herrity, Jennifer  
**Subject:** ANO-1 and 2 -- Final RAI #2 RE: LAR to Incorporate Tornado Missile Risk Evaluator (TMRE) Into Licensing Basis (EPID L-2019-LLA-0093)  
**Attachments:** Final RAI #2 for ANO TMRE LAR.pdf

On December 19, 2019, the U.S. Nuclear Regulatory Commission (NRC) staff sent Entergy Operations, Inc. (the licensee) the draft Request for Additional Information (RAI) identified below. This RAI relates to the license amendment request that would change the license basis documents for Arkansas Nuclear One, Units 1 and 2, to use the Tornado Missile Risk Evaluator (TMRE) methodology as the licensing basis to qualify several components that have been identified as not conforming to the unit-specific current licensing basis.

The NRC staff held a conference call with the licensee staff on January 7, 2020, to clarify this request. During the call, the NRC staff agreed to make minor wording changes to probabilistic risk assessment (PRA) RAIs 02.01, 05.01, and 08.01 to clarify the request. Following the call, the licensee agreed to provide a response to this RAI within 45 days of this correspondence. A publicly available version of this revised, final RAI (attached with "Draft" removed) will be placed in the NRC's Agencywide Documents Access and Management System (ADAMS).

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**From:** Wengert, Thomas  
**Sent:** Thursday, December 19, 2019 11:22 AM  
**To:** Arnold, Timothy  
**Cc:** BICE, DAVID B (ANO) ; Dixon-Herrity, Jennifer  
**Subject:** ANO-1 and 2 Draft Follow-up RAI RE: LAR to Incorporate Tornado Missile Risk Evaluator (TMRE) Into Licensing Basis (EPID L-2019-LLA-0093)

By letter dated April 29, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19119A090), as supplemented by letter dated November 14, 2019 (ADAMS Accession No. ML19322A767), Entergy Operations, Inc. submitted a license amendment request for Arkansas Nuclear One, Units 1 and 2 (ANO). Specifically, the proposed amendments would change the license basis documents for Arkansas Nuclear One, Units 1 and 2 to use the Tornado Missile Risk Evaluator (TMRE) methodology as the licensing basis to qualify several components that have been identified as not conforming to the unit-specific current licensing basis. The TMRE methodology was transmitted to the U.S. Nuclear Regulatory Commission (NRC) by the Nuclear Energy Institute (NEI) as NEI Technical Report 17-02, Revision 1, on September 21, 2017 (ADAMS Accession Nos. ML17268A033 and ML17268A036).

The NRC staff has determined that additional information, as described in the attached request for additional information (RAI), is required for the staff to complete its review of this application. This RAI is identified as draft at this time to confirm your understanding of the information that the NRC staff needs to complete the evaluation. If the request for information is understood, please respond to this RAI within 30 days of the date of this request.

Please contact me if you would like to set up a conference call with the NRC staff to clarify this request for information.

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REQUEST FOR ADDITIONAL INFORMATION  
BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO THE APPROVAL TO UTILIZE THE TORNADO MISSILE RISK EVALUATOR  
TO ANALYZE TORNADO MISSILE PROTECTION NONCONFORMANCES FOR  
ENTERGY OPERATIONS, INC.  
ARKANSAS NUCLEAR ONE, UNITS 1 AND 2  
DOCKET NOS. 50-313 AND 50-368

By application dated April 29, 2019, Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request to incorporate the TMRE in the licensing basis for Arkansas Nuclear One (ANO), Units 1 & 2.<sup>1</sup> Section 1.0 of the request states that Entergy will incorporate the Tornado Missile Risk Evaluator (TMRE) approach in accordance with Nuclear Energy Institute (NEI) 17-02, Revision 1B.

The U.S. Nuclear Regulatory Commission (NRC) staff transmitted requests for additional information (RAIs) to the licensee via electronic mail on October 7, 2019.<sup>2</sup> The licensee submitted responses to the RAIs in the supplemental letter dated November 14, 2019.<sup>3</sup>

The NRC staff have reviewed the application, as supplemented, and have identified areas where additional follow-up information is necessary for the staff to complete its technical review. The RAI numbering below is based on the numbering in the initial RAI and the licensee's response.

**PRA RAI 02.01 – ANO-1 Nonconforming SSCs Not Included in the TMRE Analysis**

Section 6.5 of NEI 17-02, Revision 1 states that the probabilistic risk assessment (PRA) logic models need to be modified to include tornado-missile-induced failures for exposed structures, systems, and components (SSCs).

In the first part of the RAI response the licensee confirmed that the basis for excluding nonconforming SSCs was not based on the system-level screening criteria of supporting requirement SY-A15 but excluded for the following reasons:

- With regards to the first nonconforming SSC excluded from the TMRE analysis, conduit EC1493, the RAI response states that the related impacted SSCs are the high point vent valves for the reactor coolant system (RCS). The response continues by stating that the venting of the RCS is currently not included in the internal events PRA (IEPRA) model.

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<sup>1</sup> Agencywide Documents Access and Management System (ADAMS) Accession No. ML19119A090.

<sup>2</sup> ADAMS Accession No. ML19280A040.

<sup>3</sup> ADAMS Accession No. ML19322A767.

- Regarding the second nonconforming SSC exclusion (i.e., the small-bore service water pipes), the response states that the impacted SSCs are the emergency switchgear room chiller units. Furthermore, it states that analysis determined that these units are not needed to fulfill any PRA-related function. Additionally, the response states that flooding from the nonconformance would not impact any PRA-modeled SSCs that would initially survive a tornado event.

The NRC staff notes that supporting requirement AS-A3 self-assessment requires modification of the IEPPRA success criteria and associated system models to account for the consequences of tornado events. Also, AS-A5 states that the TMRE PRA model is to be consistent with the system design, emergency operating procedures (EOPs), abnormal procedures, and plant transient response.

The NRC staff have noted, from previous experience, that not all of the mitigation strategies used in the EOPs or supporting procedures are included in the PRA models because they are higher-order strategies (3<sup>rd</sup>, 4<sup>th</sup>, etc.). They are not modeled because they do not significantly reduce overall risk values. In light of these observations:

- a. Provide an updated TMRE analysis using an updated TMRE PRA model that incorporates all of the nonconforming TMRE SSCs.

-OR-

- b. Provide a bounding risk value for the excluded nonconformances that is included in an updated TMRE analysis that incorporates all of the nonconforming SSCs (or surrogates modeled in the PRA).

-OR-

- c. Provide justification that the nonconforming SSCs and associated functions are not used in ANO EOPs, abnormal response procedures, or expected plant transient response to a tornado missile event.

#### **PRA RAI 05.01 – ANO TMRE Compliant-Case Conservatism Sensitivity**

The RAI response states that with no change in the degraded case risk value and reducing the compliant case risk value this will only increase the delta core damage frequency ( $\Delta$ CDF) and delta large early release frequency ( $\Delta$ LERF) values. The NRC staff notes that the bounding sensitivity example provided in the guidance (example 1) does indeed intend to maximize the  $\Delta$ CDF and  $\Delta$ LERF values. Section 7.2.2 of NEI 17-02, Revision 1B, states that the compliant case conservatism sensitivity is to address TMRE PRA modeling conservatisms added to the TMRE PRA model, as described by self-assessments of supporting requirements AS-A10, LE-C3, and SY-B7 as stated in Appendix D of NEI 17-02, which could be masking changes in risk and therefore impacting the delta-risk values.

The guidance states that conservative assumptions associated with supporting requirements AS-A10, LE-C3, and SY-B7 (i.e., supporting requirements not related to exposed equipment failure probabilities) can be addressed by setting the failure probabilities of those non-Exposed Equipment Failure Probability (EEFP) probabilities to zero in the compliant case (example 2). If the first two approaches exceed RG 1.174 thresholds, then the guidance provides example 3,

which does not set EEFPs to zero in the compliant case. The apparent approach ANO utilized in the sensitivity study was to address EEFPs by removing valid failures from both compliant and degraded cases (example 4). The NRC staff also notes the guidance states that example 4 is used in conjunction with example 3.

From the RAI response, it appears that the analysis was identifying compliant case scenarios in the degraded case cutsets to determine the relative risk impact of the scenario based on the corresponding degraded cutset risk value. It is unclear to the NRC staff what TMRE PRA modeling assumptions are being addressed in the sensitivity study provided. In light of these observations:

- a. Identify the ANO TMRE PRA modeling conservatisms addressed by this sensitivity study associated with the self-assessment of supporting requirements AS-A10, LE-C3, and SY-B7 as described in Appendix D of NEI 17-02.
- b. Explain how the LAR compliant case conservatisms sensitivity addresses the conservatisms identified in Part a.
- c. As an alternative to Part b, provide updated sensitivity studies for both units that address the conservatisms identified in Part a.

#### **PRA RAI 08.01 – Key Assumptions and Uncertainties that Could Affect the Application**

In response to the RAI, several assumptions and sources of uncertainty were provided for each unit. With regard to the uncertainty associated with thermally-induced steam generator tube ruptures (TI-SGTR), the response refers to the use of WCAP-16341 and ANO plant-specific data in analyzing TI-SGTR modeling. The NRC staff notes that WCAP-16341 states that the report's modeling is only applicable to pressurized water reactors (PWRs) with large, dry containments and designed by Combustion Engineering or Westinghouse. In contrast, ANO-1 is a Babcock & Wilcox reactor that uses once-through steam generators.

The TMRE Impact Assessment provided in the RAI response states that the change in LERF due to TI-SGTR would impact both the compliant and degraded cases. This would reduce the change in risk. The NRC staff concurs with this assessment but is uncertain what the resultant change in  $\Delta$ CDF and  $\Delta$ LERF risk values would be if this uncertainty was evaluated. ANO-1 delta-risk values are relatively near the RG 1.174 threshold. The response did not provide an assessment of the potential change in delta risk. It is not clear to the NRC staff what the impact of this uncertainty is for this application. In light of these observations:

- a. Justify the use of WCAP-16341 methodology for ANO-1 for the TMRE PRA model.
- b. Alternatively, provide a basis, such as a sensitivity study, to conclude that the source of uncertainty related to TI-SGTR does not impact the ANO-1 TMRE results.

## **PRA RAI 09.01 – ANO-1 and ANO-2 Aggregate Results**

The following PRA RAIs may result in changes to the ANO TMRE PRA models:

- PRA RAI 02.01 – ANO-1 Nonconforming SSCs Not Included in the TMRE Analysis
- PRA RAI 08.01 – Key Assumptions and Uncertainties that Could Affect the Application

The following PRA RAIs address sensitivity studies and exceedance of RG 1.174 criteria:

- PRA RAI 05.01 – ANO TMRE Compliant-Case Conservatism Sensitivity

In light of the above potential changes to the TMRE analysis:

- a. Provide updated ANO TMRE results and associated sensitivities that incorporate changes from the resolutions of these RAIs.
- b. If the guidelines from RG 1.174 applicable to TMRE PRA as discussed in NEI 17-02 are exceeded, provide justification using one of the three methods described in Section 7.3 of NEI 17-02.

## **PRA RAI 09.b.01 – ANO-1 and ANO-2 Aggregate Results**

With regards to the ANO-1 TMRE missile distribution sensitivity, which exceeds the RG 1.174 threshold for both  $\Delta$ CDF and  $\Delta$ LERF, the RAI response referred to the RAI 07.e response as justification. However, the RAI 07.e response only addressed the reasons why the LERF results were more significantly impacted than the CDF results.

Explain how the risk acceptance guidelines are met for this application. Justification may include but is not limited to the following:

- describing and providing the results of a more detailed, realistic analysis to reduce conservatism and uncertainty
- describing compensatory measures and discussing their quantifiable impact on the risk results
- discussing the conservatisms in the analysis and their quantifiable impact on the risk results