Entergy®

Entergy Operations, Inc.
P.O. Box 756
Port Gibson, Mississippi 39150

Eric A. Larson
Site Vice President
Grand Gulf Nuclear Station
Tel: 601-437-7500

10 CFR 50.90

GNRO-2018/00052

October 24, 2018

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis – Partial Response to Request for Additional Information and Extension of Response to Request for Additional Information for Remaining Questions

Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

Dear Sir or Madam:

In Reference 1, the U.S. Nuclear Regulatory Commission (NRC) transmitted Requests for Additional Information (RAIs) to Entergy Operations Inc. (EOI) to complete its review of a license amendment request (LAR). This LAR proposed incorporation of the Tornado Missile Risk Evaluator (TMRE) into the Grand Gulf Nuclear Station, Unit 1 (GGNS) licensing basis. The LAR and additional supplements were provided in Reference 2, Reference 3, and Reference 4. In Reference 5, EOI requested an extension to October 24, 2018 to complete responses to the RAIs, due to changes in the Missile Impact Parameters.

The attachment to this letter provides responses to a subset of the RAIs requested by the NRC in Reference 1. EOI has identified the need to update the GGNS Probabilistic Risk Assessment (PRA) model. The model was used to analyze the TMRE described in Reference 2. This results in the need to evaluate the impact of the PRA update on the GGNS TMRE and the applicable RAI responses. Due to this recent development, EOI will provide the responses to the remaining RAIs in early first quarter 2019. This extension will allow EOI to update the PRA model and evaluate the impact on the GGNS TMRE. This was discussed in a telephone conversation between the NRC Project Manager (Eva Brown) and GGNS Regulatory Assurance Manager (Douglas A. Neve), on October 24, 2018.

No new regulatory commitments are made in this submittal. The information provided in this submittal does not impact the No Significant Hazards Consideration analysis that was documented in the Reference 2 LAR.

In accordance with 10 CFR 50.91, "Notice for Public Comment; State Consultation," paragraph (b), a copy of this supplement, with attachment, is being provided to the designated State Officials.

Should you have any questions concerning the content of this letter, please contact Douglas Neve, Manager Regulatory Assurance, at 601-437-2103.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 24, 2018.

Sincerely,

Eric A. Larson

EAL/rws

Attachment: Response to RAI Regarding License Amendment Request to Incorporate the Tornado Missile Risk Evaluator into Licensing Basis

References:

1. NRC Letter EPID L-2017-LLA-0371, "Grand Gulf Nuclear Station Request for Additional Information, Request to Revise Updated Final Safety Analysis Report to Incorporate Tornado Missile Risk Evaluator Methodology into Licensing Basis," dated July 20, 2018 (ADAMS Accession No. ML18187A329)
2. Entergy Operations, Inc. (EOI) letter to U.S. Nuclear Regulatory Commission (NRC), "License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis," dated November 3, 2017 (ADAMS Accession No. ML17307A440)
3. EOI letter to NRC, "Supplemental Letter to License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis," dated December 6, 2017 (ADAMS Accession No. ML17340B025)
4. EOI letter to NRC, "Supplemental Letter to License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis," dated January 22, 2018 (ADAMS Accession No. ML18022A598)
5. EOI letter to NRC, "License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis - Extension of Response to Request for Additional Information," dated September 22, 2018 (ADAMS Accession No. ML18267A078)

cc: NRC Region IV - Regional Administrator
NRC Senior Resident Inspector, Grand Gulf Nuclear Station
Dr. Mary Currier, State Health Officer, Mississippi Department of Health

Attachment to GNR0-2018/0052

Response to RAI Regarding License Amendment Request to Incorporate the Tornado Missile Risk Evaluator into Licensing Basis

1. BACKGROUND

By letter dated November 3, 2017 (Reference 1), as supplemented by letters dated December 6, 2017 and January 22, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML17307A440, ML17340B025, and ML18022A598, respectively), Entergy Operations, Inc. (EOI) submitted a pilot license amendment request (LAR) regarding Grand Gulf Nuclear Station, Unit 1 (GGNS). The submittal incorporated, by reference, Nuclear Energy Institute (NEI) technical report NEI 17-02, Revision 1, "Tornado Missile Risk Evaluator (TMRE) Industry Guidance Document, "September 2017, which contains the TMRE methodology (ADAMS Accession No. ML17268A023) (hereafter referred to as NEI 17-02, Revision 1). The proposed amendment would modify the GGNS licensing bases as described in the Updated Final Safety Analysis Report to include a new methodology for determining whether physical protection from tornado-generated missiles is warranted. The methodology can only be applied to discovered conditions where tornado missile protection is not currently provided, and cannot be used to revise the design basis to avoid providing tornado missile protection in the plant modification process.

By letter dated July 20, 2018, (ADAMS Accession No. ML18187A329), the U.S. Nuclear Regulatory Commission (NRC) informed EOI that additional information is needed to support the staff review. Many of the request for additional information (RAI) questions are either identical or similar to questions asked of Southern Nuclear Operating Company (SNC) and Duke Energy Progress LLC (Duke Energy) regarding similar LARs submitted for Vogtle Electric Generating Plant and Shearon Harris Power Plant. The responses to these RAIs were submitted by SNC in a letter dated July 26, 2018 (ADAMS Accession No. ML18207A876, Reference 2) and by Duke Energy in a letter dated September 19, 2018 (ADAMS Accession No. ML18262A328, Reference 3). Following receipt of the SNC response, NRC staff provided comments in a public meeting on August 2, 2018, some of which were discussed in a letter from the NRC to SNC dated August 30, 2018 (ADAMS Accession No. ML18236A445). NRC staff perspectives shared in those public forums have informed the GGNS response.

This Attachment provides responses for a subset of the RAIs, which are due on October 24, 2018. Some of the EOI RAI responses reference docketed SNC and Duke Energy correspondence, including SNC and Duke Energy proposed changes to the TMRE methodology, to avoid redundancy. EOI has identified the need to update the GGNS Probabilistic Risk Assessment (PRA) model. This model was used to analyze the TMRE, as described in the Reference 1 LAR. This results in the need to evaluate the impact of the PRA on the GGNS TMRE and applicable RAI responses. Due to this recent development, EOI will provide responses to the remaining RAIs in early first quarter 2019 (1Q19). This extension will allow EOI to update the PRA model and evaluate the impact on the GGNS TMRE, thus providing the NRC with the most accurate information. Answers are provided for 15 total RAIs, and 2 partial RAIs, that do not rely on the PRA model.

2. RAI RESPONSES

NRC RAI 1

Section B.2, "Using EPRI NP 768 Data to Determine Missile Impact Parameter (MIP)," of Nuclear Energy Institute (NEI) 17-02, Revision 1, "Tornado Missile Risk Evaluator (TMRE) Industry Guidance Document," September 2017 (ADAMS Accession No. ML17268A036), states, in part:

> Choosing the most conservative target MIP from NP 768 (Target 4) would lead to overly conservative results for many targets at a NPP [nuclear power plant]. Therefore, the normalized tornado missile impact probability from "All Targets" in NP 768 (from Table 3 15) is proposed for use in the TMRE. This results in a MIP that is based on the combined hits on all modeled surfaces in NP 768, Plant A.

The derivation of the MIP includes the containment building (Target 1). As stated in NEI17-02, Revision 1, Section B.2, in part:

> [t]he containment building is surrounded by other buildings ...so only the upper part of the containment is exposed to tornado missiles.

Additionally, the elevation of the exposed upper part of the containment is different from the elevation of other targets included in the calculation of near ground missiles.

Due to the overall height and the large surface area of the containment building, many missiles may be unable to reach upper portions of the containment building, which reduces the overall density of missile strikes and could become unrepresentative of other shorter plant buildings.

Section 3.2.3.2, "Missile Impact and Damage Probability Estimates," of the Electric Power Research Institute (EPRI) topical report NP 768, "Tornado Missile Risk Analysis," May 1978, states, in part:

> [t]he individual target contributions to the total hit probability is generally greater for the larger targets but least for the containment structure (7.65 x 10 10, Table 3 8) which is shielded from impact for the first 60 feet [(ft.)] above ground elevation.

Justify including Target 1 (containment building) of Plant A in EPRI NP 768 in computing the average MIP for targets less than 30 ft. above grade, given that the containment building is shielded by other buildings and is not impacted by near ground missiles. Discuss how inclusion of Plant A containment building in computation of the average MIP for targets less than 30 ft above grade impacts this application.

EOI Response to RAI 1

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 2

Section B.4, "MIP Values for Use in the TMRE," of NEI 17-02, Revision 1, provides two sets of MIP values, one for elevated targets and one for near ground targets. The demarcation between near ground and elevated targets is 30 ft. above the primary missile source for a target. For targets near the ground, the MIP appears to be derived using the target areas listed in Table B-2 of NEI 17-02, Revision 1, which generally excludes the area of the roof (with an exception for Target 6, which includes the area of the roof). For the elevated MIP value, the area used to derive the MIP includes all the areas listed in Table B-1 of NEI 17-02, Revision 1, which includes roof areas.

a. The EPRI topical report NP-768 Plant A targets vary in height from 20 to 230 ft. With the exception of the Target 1 (containment building), the buildings range in height from 20 to 80 ft. The weighted average (weighted by the wall area) height of all targets is 94 ft. The weighted average (weighted by the wall area) height of the targets is 56 ft. if Target 1 is excluded.

   Provide the basis for the 30 ft. demarcation between near ground and elevated targets, given that EPRI NP-768 Plant A buildings range in height from 20 to 230 ft.

b. The MIPs calculated for elevated targets in Section B.4 are about 54 percent of the MIPs calculated for near ground targets. This percentage seems to reflect the assumptions with respect to areas included in calculation of MIPs for elevated and near ground targets. The difference in area appears to be the only factor that determined the difference between MIPs for elevated and near ground targets. One of the sensitivity analyses in Appendix E of NEI 17-02, Revision 1, examines the impact of target elevation on target hit probabilities. Revision 1 of NEI 17-02 states that the results of this sensitivity analysis show that in general as target elevation increases, hit probability decreases.

   Describe the relationship between the numerical results shown in Appendix E and address whether the Appendix E results are generally consistent with the ratio of elevated to near ground MIPs calculated in Appendix B, "Bases for MIP and Missile Inventories." If Appendix E numerical results are not consistent with the ratio calculated in Appendix B, provide a justification

EOI Response to RAI 2

a. Section B.3.4 of Enclosure 2 to Reference 2 provides the bases for the 30 ft. demarcation. GGNS has conservatively assumed near ground target MIPs for all non-conformances and vulnerabilities in its TMRE analysis.

b. The results of the elevated sensitivities in NEI 17-02 Revision 1 Appendix E are consistent with the relative differences between the near ground and elevated MIPs derived in Appendix B and presented in Table 5-1. This is documented in Enclosure 2 of Reference 2.

NRC RAI 3

Section 5, "Evaluate Target and Missile Characteristics," of NEI 17-02, Revision 1, states, in part, that:

> [t]he <30 ft. MIP value can be used in cases where it is difficult to determine if the target is >30 ft. above all missile sources.

Table 5 1 in NEI 17-02, Revision 1, refers to targets that are 30 ft. above or below "grade," and Note 2 to the table explains:

> [t]he term grade here is meant to refer to the elevation at which a majority of the missiles that can affect the target is located. Typically, this is plant grade, although for some targets it may be different.

The above discussions in Sections 5 and 5.1 of NEI 17-02, Revision 1, seem to provide different guidance regarding how to determine elevated targets (for which the MIP values are different). The NRC staff notes that missiles may exist at elevations above some nominal plant grade or that targets exist at elevations that are above and below the nominal plant grade.

a. Describe the process that GGNS has used for determining near ground and elevated targets considering various elevations of targets and missiles. The description should include how this process ensures proper consideration of missile source applicability for each target relative to the demarcation height.

b. The hit frequency in EPRI NP-768 is a function of the insertion height of the missiles. In EPRI NP-768, the missiles were assumed inserted from heights ranging from 5 to 50 ft., except for cars, which were assumed inserted from 5 to 10 ft.

   Address whether the range of cited insertion heights underestimates the hit probabilities.

EOI Response to RAI 3

a. For GGNS, near ground target MIP values were utilized in calculating EEFPs for all vulnerabilities and non-conformances. Therefore, no process was used in determining difference between near ground and elevated targets.

b. Section B.3.4 of Enclosure 2 to Reference 2, provides a discussion of the effects of missile insertion height on the MIP and compares the NP-768 simulations missile insertion elevations with missile height data from several plants.

   The TMRE guidance does not require that individual licensees validate missile injection heights, based on the data provided in Section B.3. Since the NP-768 missile insertion heights are bounded by the sampled data, which is representative of nuclear plant sites in the U.S., it is not required that any individual plant perform this analysis.

NRC RAI 4

Section 3.3.1 of the submittal states that "PRA logic and components that do not support mitigating a [loss of offsite power] LOOP can be screened" since the TMRE model uses non-recoverable LOOP sequences. Section 6.1 of NEI 17-02, Revision 1 states that, in addition to LOOP event trees, other internal initiating events should also be reviewed to ensure that either (1) a tornado event cannot cause another initiating event or (2) the impact of the initiating event can be represented in the logic selected to represent the tornado-initiating event. It was not clear whether the review discussed in Section 6.1 of NEI 17-02 was performed by the licensee to support this submittal. For example, the standby service water cooling tower (SSW CT) fans are an identified vulnerability which, according to Section 3.3.9 of the enclosure to the submittal, "are important in that they support the operation of the emergency diesel generators and the [emergency core cooling] ECCS systems." The SSW CT fans do not appear to have been reviewed as initiators or as support system losses that need to be included in the sequences. The walkdowns also appear to have been performed with a focus on the LOOP mitigation and other initiators or support system failures do not appear to have been considered during the walkdowns.

Describe whether a review was performed to ensure that a tornado event cannot cause another initiating event or the impact of the initiating event can be represented in the logic selected to represent the tornado-initiating event. Provide the results of this review including a discussion of any potential impact on and from walkdowns.

EOI Response to RAI 4

As part of the GGNS TMRE PRA development, a review of each of the initiating events in the GGNS PRA was performed to determine which of them could be caused by a tornado, and to determine if the initiating events that are determined to be susceptible to tornado induced initiation are represented by the LOOP initiating event logic, or if a separate evaluation needs to be performed. It was determined that the LOOP and SBO accident sequences adequately represent the plant response to the tornado.

The results of this review, including insights from the walkdowns performed, are shown in the following table.

Initiator	Description	Tornado Induced?	Notes
%A	Large LOCA	No	Not directly caused by tornado.
%E	Reactor Vessel Rupture	No	Not directly caused by tornado.
%ISL	Interfacing System LOCA	No	Not directly caused by tornado.
%MF	Internal Major Flooding Events	No	Not directly caused by tornado. Although a tornado missile could impact/rupture a pipe, the walkdowns did not identify any piping that was susceptible to tornado damage that would result in a major internal flood initiating event if impacted by a missile.
%F	Internal Flooding Events	Yes	Walkdowns did identify SSW piping that was susceptible to tornado damage that would result in an internal flood initiating event if impacted by a missile. But the internal flooding events of concern would result in a trip which would be represented by the LOOP event and this flooding would be bounded by the LOOP event. Therefore, this initiator is not evaluated separately.

Initiator	Description	Tornado Induced?	Notes
%SP	Internal Flood Spray Events	No	Not directly caused by tornado. Although a tornado missile could impact a pipe causing it to spray, the walkdowns did not identify any piping that was susceptible to tornado damage that would result in an internal flood spray initiating event if impacted by a missile.
%H	Internal Flood HELB Events	No	Not directly caused by tornado. Although a tornado missile could impact a pipe causing it to spray, the walkdowns did not identify any piping that was susceptible to tornado damage that would result in an internal flood HELB initiating event if impacted by a missile.
%HF	Internal Flood HELB with Flood Effects Events	No	Not directly caused by tornado. Although a tornado missile could impact a pipe causing it to spray, the walkdowns did not identify any piping that was susceptible to tornado damage that would result in an internal flood HELB with Flood effects initiating event if impacted by a missile.
%S1	Intermediate LOCA	No	Not directly caused by tornado.
%S2	Small LOCA	No	Not directly caused by tornado.
%S3	Small Small LOCA	No	Not directly caused by tornado.
%T1	Loss of offsite Power	Yes	Initiated by switchyard failures or grid failures
%T1P	Loss of 500 KV Power	Yes	Bounded by LOSP – Therefore, this initiator is not evaluated separately

Initiator	Description	Tornado Induced?	Notes
%T2	Loss of PCS	Yes	Several MFW components are considered "vulnerable" to a tornado, and failure of these MFW components could result in a reactor trip, but the trip would be represented by the LOOP event and would be bounded by the LOOP event. Therefore, this initiator is not evaluated separately.
%T2M	Closure of MSIVs	No	Not directly caused by tornado.
%T3A	PCS Available Transient	Yes	Several components (e.g. main trip valves) are considered "vulnerable" to a tornado, and failure of these components could result in a reactor trip, but the trip would be represented by the LOOP event and would be bounded by the LOOP event. Therefore, this initiator is not evaluated separately.
%T3B	Loss of Condensate Feed Water Pumps	Yes	Several MFW components are considered "vulnerable" to a tornado, and failure of these MFW components could result in a reactor trip, but the trip would be represented by the LOOP event and would be bounded by the LOOP event. Therefore, this initiator is not evaluated separately.
%T3C	Inadvertent Open Relief Valve	No	Not directly caused by tornado.
%TAC1	Loss of AC Division 1	No	Not directly caused by tornado.
%TAC2	Loss of AC Division 2	No	Not directly caused by tornado.

Initiator	Description	Tornado Induced?	Notes
%TCCW	Loss of Component Cooling Water	No	Not directly caused by tornado.
%TCRD	Loss of Control Rod Drive	No	Not directly caused by tornado.
%TDC1	Loss of DC Division 1	No	Not directly caused by tornado. Although Battery 1K3 was determined to be "Vulnerable" based on the walkdowns, its failure would not result in a Loss of DC Division 1 trip.
%TDC2	Loss of DC Division 2	No	Not directly caused by tornado.
%TIA	Loss of Instrument Air	No	Not directly caused by tornado. No IA components that would result in a Loss of IA trip were identified during the walkdowns as being non-conforming or vulnerable.
%TPSW	Loss of Plant Service Water	No	Not directly caused by tornado.
%TRLA	CRD Reference Leg Leak Down	No	Not directly caused by tornado.
%TRLB	CRD Reference Leg Leak Down	No	Not directly caused by tornado.
%TST11	Loss of Service Transformer 11	Yes	Bounded by LOSP – Therefore, this initiator is not evaluated separately
%TST21	Loss of Service Transformer 21	Yes	Bounded by LOSP – Therefore, this initiator is not evaluated separately
%TTBCW	Loss of Turbine Building Cooling Water	No	Not directly caused by tornado.

NRC RAI 5

Section 3.2.3, "SSC [Structures, Systems, and Components] Failure Modes," of NEI 17-02, Revision 1, references consequential failures and describes treatment of identified and documented cases to be addressed in Section 6, "Develop TMRE PRA Model," of NEI 17-02, Revision 1. Specifically, the first bullet in Section 3.2.3 characterizes tanks and piping as "passive" components.

Section 3.2.3 does not appear to include guidance on consideration of secondary effects. Such effects include consideration for fluid filled tanks and pipes, combustion motor intake effects (loss of oxygen from inert gas tank rupture or exhaust re direction scenarios), and other potential secondary effects to the SSCs' function.

Describe how secondary effects that may result from failure of non-conforming conditions were considered for identification of the initiating events and failure modes in the licensee's TMRE development.

EOI Response to RAI 5

> *The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.*

NRC RAI 6

Section 3.4.3, "Temporary Missiles," of NEI 17-02, Revision 1, states that the expected missile inventory for the post construction site should be estimated, using walkdown results for the non-construction areas, information in Sections 3.4.2, "Non-Structural Missile Inventory," and 3.4.4, "Structural Missiles," along with design and construction information. The section states that the basis and assumptions used for the estimated number of post construction missiles will be documented. The November 3, 2017 license amendment request (LAR) (ADAMS Accession No. ML 17307A440), does not appear to provide a basis for the adequacy of missile counts for post-construction site.

Section 3.4.3 of NEI 17-02, Revision 1, states the total missile count for the sensitivity analysis should include the non-construction related missile inventory determined in accordance with Sections 3.4.2 and 3.4.4, and a conservative estimate of the number of all construction related missiles. The NEI guidance further states that the basis and assumptions used to determine the conservative construction missile estimate should be documented. The LAR does not appear to provide a basis for the adequacy of construction related missile counts.

a. Describe and justify the approach that will be used for the classification of the construction related missiles in GGNS's future implementation of the TMRE methodology.

b. Section 3.4.3 of NEI 17-02, Revision 1, states that it is not necessary to explicitly account for the additional outage related missiles in the TMRE missile inventory. The guidance further states that outages are of relatively short duration compared to the operational time at a nuclear power plant. The NRC staff notes that duration of outages or other temporary activities that involve bringing additional equipment to the sites may be relatively long, specifically for a multi-unit site. It does not appear that GGNS has considered additional equipment (such as outage conditions) in estimating the number of missiles.

Clarify whether GGNS outage related missiles were considered in the total number of missiles used for GGNS TMRE implementation. Provide a justification if those missiles are not considered in estimating the total number of missiles at the site.

c. Section 3.4, "Tornado Missile Identification and Classification," of NEI 17-02, Revision 1, provides guidance for verifying the number of missiles resulting from the deconstruction of various types of buildings through the TMRE walkdown.

   The guidance does not appear to involve walkdowns to count the potential missiles a non-Category I building contains inside the structure or to count missiles that would be generated by the deconstruction of the structure itself. The guidance should ensure that the missile inventories from building deconstruction are not underpredicted for a specific plant.

   i. For each type of building addressed in NEI 17-02, Revision 1, explain how GGNS missile count considers building contents (i.e., materials that are not part of the building itself but available to become missiles if the building is hit).

   ii. For those types of buildings where the NEI 17-02, Revision 1, methodology was applied, verify that the overall estimate of non-structural missiles within buildings is representative or bounding.

EOI Response to RAI 6

a. In future applications of the TMRE methodology, it is unlikely that the number of missiles included in the Grand Gulf TMRE calculations will change significantly because Grand Gulf is not currently planning any large-scale construction projects. If a major construction project is undertaken by Grand Gulf, sensitivity analyses will be performed to evaluate the impact of additional non-permanent construction-related missiles (i.e., those missiles not already included in the permanent post-construction missiles) above the missile count used in the TMRE analysis. Non-permanent construction-related missiles will be considered during plant changes that trigger a TMRE evaluation, and will either be included in the primary analysis or will be analyzed through a sensitivity study.

   The GGNS missile walkdown was performed in accordance with Section 3.4 of NEI 17-02, Revision 1. To support the walkdowns, the plant was divided into zones. The potential missile count for each zone was determined. The missile count is summarized in Table 3-1 of the Reference 1 LAR. Some equipment used during outages is stored elsewhere on site during non-outage times to prevent having to purchase new outage support equipment before each outage. The total GGNS missile estimate is 233,980 which provides margin to the NEI TMRE guidance of 240,000, which was used in the GGNS TMRE calculations.

Non-permanent construction-related missiles will be considered if additional non-conforming SSCs are identified, and will either be included in the primary analysis or will be analyzed through a sensitivity analysis per NEI 17-02, Revision 1B.

b. Consistent with the guidance provided in NEI 17-02, Revision 1B, additional outage missiles were not considered as part of the TMRE walkdown. It is an acceptable approach as outage durations are short and at multi-unit sites generally outage is staggered and only one unit is under outage at a time. Furthermore, GGNS is a single unit site. Site procedures require securing equipment during severe weather and, during outage, there will be additional staff available to secure this equipment.

   Additionally, scaffolding parts/accessories provide the majority of additional missiles during an outage. These scaffolding pieces are usually stored onsite and are already included in missile count from a different plant area. Other equipment (machinery, trailers, and vehicles) will result in a small percentage increase as compared to the missile count of 240,000 that was used. The total missile count at GGNS is 233,980. Since this is bounded by the generic value of 240,000 provided in NEI 17-02, Revision 1, the missile count of 240,000 was conservatively utilized in calculating EEFPs. The additional outage missiles at GGNS are expected to be bounded by the generic missile count of 240,000.

c. (i) The tornado missile count walkdown considered both non-structural missile inventory and structural missiles. Non-structural missiles are objects around the site that are not part of a structure. Table 3.2 of NEI 17-02, Revision 1 categorizes the non-structural missiles into 23 types. Per Section 3.4.2 of NEI 17-02, the TMRE method does not require a missile count of each type of missile, as the missile counts described in Tables 3-3 through 3-8 explicitly consider estimates of building contents.

   In accordance with Section 3.4.4 of NEI 17-02, Revision 1B, structural missiles are missiles resulting from the destruction of commercial and industrial structures that are not designed to withstand tornados. Therefore, any non-Category I structure or non-concrete framed structure is considered to produce structural missiles. To simplify this portion of the missile count, Tables 3-3 through 3-8 of NEI 17-02 provide an estimation of structural missile counts based on the type of structure. Note that these tables include missile quantities for contents of structures. However, the warehouse content quantities are for an estimation of pallets, drums, and shelving; therefore, the quantities of items stored on the pallets and shelves or in the drums were added to the missile count.

   NEI 17-02, Revision 1B, Section C.4 describes that wind pressures from tornadoes can be sufficiently high to cause structural damage to portions of building. Damage to buildings can range from localized (pieces of siding) to complete failure of the wall and roof systems. Debris from these damaged buildings can generate additional missile hazards. NEI 17-02, Revision 1B, Section C.4 considers a range of building types, such as wood framed, manufactured, pre-engineered, and engineered. As these types of buildings are found on power plant sites, an estimation of the number of available missiles for each building type was performed. The number of available missiles was estimated from typical building layouts and construction practices. In addition, it was assumed that each building type was constructed from components that are similar to those found on the EPRI missile spectrum (NEI 17-02, Table 3-2), such as steel I-beams, steel channels, and metal siding (in the case of steel buildings). Similarly, the building contents for each building type were also assumed to be similar to components on the EPRI missile spectrum (e.g., cable reel, or a gas cylinder).

Based on a representative building for each construction type, the total number of building components was approximated. The numbers of missiles, for a range of typical building types, are shown in NEI 17-02, Revision 1, Tables C-6 through C-11. To help clarify the approach used for estimating the total number of building components, an example evaluation of a pre-engineered metal warehouse building is provided in Section C.4 of NEI 17-02. The approach described is similar for the other building types (wood-framed and manufactured). The contents of the warehouse are assumed to be representative of construction equipment/supplies or items used in outages (tool bins, cable reels, lumber, generators, etc.). The quantities of stored items were based mainly on filling available shelf and floor area. Based on the warehouse general arrangement, the building is judged to be moderately stocked and not sparsely loaded.

The process for estimating debris from damaged buildings (including contents) is based on realistic assumptions for building construction types as well as assumptions relating to stored contents. However, it is judged that the approach for considering building contents yields a conservative estimate of EPRI missile types and quantities.

- Building contents are assumed to be wind-borne missiles even for low wind speeds. However, in real tornado wind events, building contents would not be released until building failure is reached, which is at much higher wind speeds. This assumption leads to a conservative missile count.

- The consideration of building structural missiles in NEI 17-02 is conservative because all structural components of the building are assumed to detach from one another and become wind-borne. Most real wind-induced building failures result in a distribution of structural debris sizes rather than complete deconstruction of the building structural components. In many cases, the failure of exterior cladding or structural components can lead to reduced pressures on the structural frame; decreasing the likelihood of all members becoming completely deconstructed. This assumption leads to a conservative missile count.

Based on the use of realistic assumptions for building construction and stored contents, and conservative assumptions relating to building failure, it is judged that the TMRE approach for evaluating debris from damaged structures is reasonable and satisfies the requirements of RG 1.174 (Position 2.3.3).

(ii) The NEI 17-02 methodology was applied to all buildings to estimate the missiles resulting from building deconstruction. Tables C-9 through C-14 of Enclosure 2 to

Reference 2 consider both structural and non-structural missiles in the missiles estimates. A walkdown of the GGNS warehouse contents demonstrated that the non-structural missiles in the warehouse were consistent with the assumptions built into NEI 17- 02 Tables C-9 through C-14 of Enclosure 2 to Reference 2. A limited walkdown of the GGNS Mechanical and Engineering Building demonstrated that assumptions for file cabinets in office buildings were reasonable.

NEI 17-02 was updated to reflect that the estimates are consistent with actual counts at a nuclear plant. Therefore, the future applications of TMRE may use this methodology without additional plant-specific justifications.

NRC RAI 7

Section 3.3.5 "Target Evaluation" and the notes to Table 3.3 to the Enclosure of the submittal implies that robustness of targets with respect to certain missile types is not considered anywhere in quantification and that any missile is considered to fail any target completely. The submittal indicates that this methodology is intended to be applied to future discoveries or as-built non-conforming conditions, but does not describe how this provision will be applied.

Sections 5.2, "Missile Inventories," and 5.2.1, "Missile Inventory Example," of NEI 17-02, Revision 1, explain that a bounding inventory of missiles was developed from a survey of five plants along with a generic distribution of missile types. These sections explain that the missile types and target robustness categories are used to determine if a target fails. Section 5.2 explains that in using the TMRE approach, the missiles at a specific plant should be counted to ensure that the missile inventory at the plant is bounded by the inventory used in the TMRE methodology based on the survey. Finally, Section B.6, "Missiles Affecting Robust Targets," of NEI 17-01, Revision 1, states that the number of missiles used in the Exposed Equipment Failure Probability (EEFP) calculation can be adjusted to account for the population of missiles that can damage an SSC and provides the percentage of the total missile inventory for each type of robust target. These percentages appear to depend on specific missile type counts taken from two plant missile inventories as shown in Tables B-15, B-16, and B-17.

The sections of NEI 17-02, Revision 1, cited above do not appear to provide guidance for adjusting the relative contribution of each missile type based on plant specific information. A skewed distribution of missile types at a specific plant site could have an impact on the risk results of the TMRE probabilistic risk assessment (PRA), because certain missiles (from certain missile robustness categories) can fail a greater number of SSCs than missiles from lesser robustness categories.

Describe how any future use of the TMRE guidance for adjusting the number of missiles for robust targets at GGNS will be performed to ensure GGNS evaluation will ensure that the contribution of each missile type to the overall missile population in NEI 17-02, Revision 1, is representative of the contribution of each missile type to the overall missile population at GGNS.

EOI Response to RAI 7

As described in NEI 17-02, Revision 1 and stated in previous public meetings, the intent of the TMRE methodology is to provide a generic method for assessing tornado missile risk. The robust missile percentages are intended to be generic values that do not require detailed site-specific calculations. Since the robust missile calculations are based on data from two sites, it is acknowledged that site specific missile distributions will invariably be different. It is also acknowledged that changes to the robust missile percentages will affect SSC tornado missile failure probabilities (i.e., EEFPs). However, the robust missile percentages were derived in a conservative manner, especially with regard to the damage potential of missiles to targets. The guidance in NEI 17-02, Revision 1 does not require a validation of missile inventory percentages. Therefore, GGNS does not intend to adjust or validate the contribution of each missile type to the overall missile population in the future.

In the future, GGNS may choose to implement the TMRE guidance found in Enclosure 2 to Reference 3 for adjusting the number of missiles for robust targets, using the generic values provided in Table 5-2. The robust missile percentages in Table 5-2 were determined from two representative sites, as documented in Tables B-15, B-16 and B-17 of Enclosure 2 to Reference 3. This guidance does not require sites to compare their missile counts or recalculate robust percentages based on the site-specific distribution of missile types. Given the conservative nature of the robust missile calculations provided in Appendix C of NEI 17-02, Revision 1B, the robust missile data in Table 5-2 of NEI 17-02, Revision 1, is appropriate for use at all sites.

NRC RAI 8

Section 5.3, "Target Exposed Area," of NEI 17-02, Revision 1, provides the method for calculating the area of an SSC that is exposed to being struck by a tornado missile for various types of SSCs and how their target exposed area should be calculated for the EEFP. When calculating surface area, some components (e.g., tanks, ultimate heat sink fans, etc.) are susceptible to potential missiles in the vertical direction that could result in additional exposed area. The GGNS licensing basis defines parameters for missile velocities in both horizontal and vertical directions in the GGNS UFSAR, Table 3.5.1-6, "Tornado Missiles Considered in the GGNS Design."

Section 3.3.2, "Target Walkdowns," of the Enclosure to the submittal provides the scope of TMRE walkdowns. The third bullet of Section 3.3.2 includes identifications of "directions from which tornado missiles could strike the target" in the scope of walkdowns. It does not appear to differentiate between horizontal and vertical missiles consistent with the GGNS licensing basis.

Considering that tornado missiles could strike from all directions, describe how the above bulleted item in Section 3.3.2 of the Enclosure to the submittal was performed and how vertical missiles and directional aspects are included in the GGNS TMRE.

EOI Response to RAI 8

The GGNS TMRE considered that a target SSC could be struck from all directions unless a substantial structure existed which would provide shielding from one or more directions. For example: The fuel oil storage tank vents were considered vulnerable to missiles from all four sides and the top. However, because the piping in the SSW pump room is surrounded by two-foot thick concrete walls, the piping is vulnerable only to missiles entering through the wall openings.

NRC RAI 9

One of the key principles in RG 1.174, Revision 2, "An Approach For Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant Specific Changes to the Licensing Basis," May 2011 (ADAMS Access No. ML100910006), states that the proposed change meets the current regulations unless it is explicitly related to a requested exemption.

Section 2.2, "Current Licensing Basis (CLB)," of the Enclosure to the submittal states that GGNS was designed to meet General Design Criterion (GDC) 2, "Design bases for protection against natural phenomena," and GDC 4, "Environmental and dynamic effects design bases," in Appendix A to Part 50 of Title 10 of the Code of Federal Regulations (10 CFR). GDC 2 states that SSCs important to safety be designed to withstand the effects of natural phenomena such as tornadoes without loss of capability to perform their safety functions. GDC 4 states that SSCs important to safety be designed to accommodate the effects of missiles that may result from events and conditions outside the nuclear power unit, which includes tornadoes.

Section 4.1, "Applicable Regulatory Requirements/Criteria," of the Enclosure to the submittal states that Section 3.5.1.4, "Missiles Generated by Tornadoes and Extreme Winds," of NUREG 0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP), allows for a probabilistic basis for "relaxation of deterministic criteria" for tornado missile protection of SSCs. The submittal further states that "RG 1.174 establishes criteria to quantify the 'sufficiently small' frequency of damage" discussed in the SRP. However, the cited SRP sections discuss the probability of occurrence of events and not the change in core damage frequency (CDF) and large early release frequency (LERF). The probabilistic criteria in SRP 3.5.1.4 (i.e., the probability of damage to unprotected safety related features) is not directly comparable to RG 1.174 acceptance guidelines.

Address how the proposed methodology will continue to provide reasonable assurance that the SSCs important to safety will continue to withstand the effects of missiles from tornados or other external events without loss of capability to perform their safety function.

EOI Response to RAI 9

Use of the proposed methodology will continue to provide reasonable assurance of the protection of public health and safety and the environment as described in the Updated Final Safety Analysis Report (UFSAR) without loss of the tornado safe shutdown capability.

Use of the proposed methodology will not result in an increase in the likelihood of a tornado. The design basis tornado frequency is driven by external factors and is not affected by use of this methodology. Further, use of this methodology does not increase the consequences of a tornado. Use of the methodology does not alter any input assumptions or the results of the accident analysis. Use of the methodology results in more realistic assessment of the very low likelihood of unacceptable consequences from a tornado event. Use of the methodology results in no physical changes to the facility so no new types of malfunctions or accidents are created.

The types of accidents, accident precursors, failure mechanisms and accident initiators already evaluated in the UFSAR remain unaltered. Finally use of the methodology does not reduce the margin of safety in the UFSAR. Use of the methodology does not exceed or alter any controlling numerical value for a parameter established in the UFSAR Chapter 6 and 15 safety analyses, and those analyses remain valid. Use of the methodology does not reduce redundancy or diversity of safety systems, nor does it reduce defense-in-depth as described in the UFSAR.

NRC RAI 10

Regulatory Position 2.1.1, "Defense-in-Depth," in RG 1.174, Revision 2, discusses defense-in-depth as one of the key principles of risk-informed integrated decision-making. This regulatory position states that the engineering evaluation should evaluate whether the impact of the proposed licensing basis change (individually and cumulatively) is consistent with the defense-in-depth philosophy. Section 3.2.1 of the Enclosure to the submittal discusses licensee's assessment of defense-in-depth considerations for this application.

One of the items listed in support of the conclusion that "defenses against human errors are preserved" in Section 3.2, "Traditional Engineering Considerations," of the Enclosure to the submittal refers to a licensee procedure that includes "post-tornado walkdowns for tornado missile vulnerable SSCs." It is further stated that the procedure "includes a table of plant vulnerabilities to tornado-generated missiles and recovery actions that reduce the impact of a tornado missile affecting the identified SSCs."

Discuss whether any vulnerabilities were identified during the licensee's TMRE PRA development that were not present in the procedure cited by the licensee and any changes to the procedure resulting from the licensee's TMRE PRA development.

EOI Response to RAI 10

The procedure referred to in the enclosure to the submittal is site procedure 05-1-02-VI-2 "Off-Normal Event Procedure Hurricanes, Tornados, and Severe Weather". Steps within this procedure require the performance of several supporting procedures. Notably, two of the procedures that are required if a tornado/high wind event is experienced are: fleet procedure EN-FAP-EP-012 "Severe Weather Recovery", and site procedure 06-TE-1000-V-0001 "Surveillance Procedure Culvert No 1 Embankment Stability Inspection/Survey". A review of the TMRE identified plant vulnerabilities against the list in the procedures did not identify any new "Structures or Systems" that required inclusion in the procedures.

The purpose of 05-1-02-VI-2 is to provide instruction during periods before AND during hurricanes, tornadoes AND severe weather. Its main focus is to help maintain the plant on-line AND protect the safety of on-site personnel. Additionally, the procedure instructs the shutdown of the SSW Cooling Tower fans be performed until the storm has passed unless they are required for specific functions and the closure of doors to prevent building depressurization and/or shelter equipment.

If sustained winds of greater than 24 mph are experienced, 05-1-02-VI-2 requires the visual surveillance of the SSW basin areas, the DG ventilation intake structures, the Dry Fuel Storage Area, and performance of EN-FAP-EP-012. For a tornado on site, the procedure instructs Radiation Protection (RP) personnel to perform radiological surveys of the Dry Fuel Storage Area, and inspections of the Casks for damage, and also instructs the coordination with the Switchyard POC to inspect the switchyard for damage. The procedure also requires performance of site procedure 06-TE-1000-V-0001 per TRM SR 6.7.5.1 in the event a hurricane, tornado, OR intense rainfall has occurred. Since 05-1-02-VI-2 is focused on the bigger picture, the specific insights from the TMRE walkdowns are determined to not be appropriate for inclusion in this procedure. The insights from the TMRE walkdowns were then evaluated for enhancement of the two procedures that 05-1-02-VI-2 relies on to ensure the plant and site is in good condition following the occurrence of a severe weather event: EN-FAP-EP-012, and 06-TE-1000-V-0001. This evaluation did not result in any changes or enhancements to either procedure.

Procedure 06-TE-1000-V-0001 is focused on ensuring that embankments on-site at GGNS are not washed out and culverts on-site are not blocked. The main focus of these checks is to prevent an external flooding event, and to ensure safe travel paths.

Procedure EN-FAP-EP-012 is a fleet procedure that provides guidance during recovery efforts associated with severe weather or other natural events (including tornadoes) and provides guidance on responding to site emergencies following the passage of natural disasters or area blackouts directly or indirectly affecting the site's 10-mile Emergency Planning Zone. Since it is a fleet procedure, it is not plant specific, but uses "generic" terminology that is applicable to all the Entergy Nuclear sites such as saying "Building" instead of "Auxiliary Building". In particular, Attachment 7.2 is the Site Severe Weather Recovery Checklist, and Attachment 7.5 provides the instructions for performing site walkdowns once the severe weather conditions have passed. A review of the checklists in these attachments was performed and determined that some steps in the checklist address the GGNS identified vulnerabilities. No changes to this procedure were identified as a result of the TMRE walkdowns or development of the TMRE analysis.

NRC RAI 11

Regulatory Position 2.1.1 in RG 1.174, Revision 2, discusses defense-in-depth as one of the key principles of risk-informed integrated decision-making. This regulatory position states that one of the considerations in the assessment of whether the proposed change meets the defense-in-depth philosophy is to determine whether over-reliance on programmatic activities as compensatory measures associated with the proposed change is avoided.

Diverse and Flexible Coping Strategies (FLEX) equipment is cited as a defense-in-depth feature in Section 3.2 of the Enclosure to the submittal. It is stated that "critical equipment is stored in structures that would prevent it from being impacted by a tornado or tornado missile."

For each non-conforming condition, describe how the FLEX equipment will provide additional defense-in-depth in the context of the assumptions used for the TMRE PRA including the lack of credit for operator actions outside protected structures and the potential for staged equipment becoming missiles.

EOI Response to RAI 11

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 12

Regulatory Position 2.1.1 in RG 1.174, Revision 2, discusses defense-in-depth as one of the key principles of risk-informed integrated decision making. This Regulatory Position states that the engineering evaluation should evaluate whether the impact of the proposed licensing basis change (individually and cumulatively) is consistent with the defense-in-depth philosophy. Section 3.2.1, "Defense-in-Depth," of the Enclosure to the submittal discusses the licensee's assessment of defense-in-depth considerations for this application. The assessment does not appear to fully address all seven defense-in-depth considerations discussed in Regulatory Position 2.1.1.

Provide an evaluation of the impact of the proposed changes, individually and cumulatively, on the following defense-in-depth considerations contained in RG 1.174:

- System redundancy, independence, and diversity are preserved commensurate with the expected frequency, consequences of challenges to the system, and uncertainties (e.g., no risk outliers).

- Defenses against potential common cause failures are preserved, and the potential for the introduction of new common cause failure mechanisms is assessed.

- The intent of the plant's design criteria is maintained.

EOI Response to RAI 12

The proposed change does not modify the redundancy, independence, or diversity of systems described in the GGNS UFSAR. Challenges to the systems, considering the frequency, consequence, and uncertainties of events, are evaluated in the LAR. The availability and reliability of SSCs that can either initiate or mitigate events is not changed, except for the tornado missile protection of the SSCs listed and thoroughly evaluated in the LAR. Equipment credited for Diverse and Flexible Coping Strategies (FLEX) is available both onsite and offsite. This equipment could be utilized, if needed, to mitigate the impact of a tornado missile. The equipment is stored in structures that ensure availability in the case of a tornado or tornado missile.

Defenses against potential common-cause failures are preserved and the potential for the introduction of new common-cause failure mechanisms is assessed in the LAR. The non-conforming conditions described in the LAR are spatially distributed about the GGNS site with differing orientation and elevation. Any combination of non-conforming conditions that could realistically be struck by the same missile are correlated within the analysis and evaluated as such. The physical distribution of the non-conformances ensures that a single missile cannot, for example, strike both the Diesel Generator Fuel Oil Day Tank Vents and the SSW Supply and Return Headers.

The LAR maintains the intent of the plant design criteria for tornado missile protection, which is to provide reasonable assurance of achieving and maintaining safe shutdown in the event of a tornado. The evaluation performed and documented in this LAR demonstrates that the risk associated with the proposed change is very small and within accepted guidance for protection of public health and safety. The LAR only affects plant design criteria related to tornado missile protection, and a very small fraction of the overall system areas would remain not protected from tornado missiles. All other aspects of the plant design criteria are unaffected. Additionally, the methodology utilized in the LAR cannot be used in the modification process for a future plant change to avoid providing tornado missile protection. The methodology only applies to legacy plant issues. Protection of the identified non-conforming SSCs would assure that they would not be damaged by design basis tornado missiles. In lieu of protection for the identified non-conforming SSCs, GGNS has analyzed the actual exposure of the SSCs, the potential for impact by damaging tornado missiles, and the consequent effect on CDF and LERF. While there is some slight reduction in protection from a defense-in-depth perspective, the impact is known, and it is negligible. Therefore, the intent of the plant's design criteria is maintained.

NRC RAI 13

Regulatory Position 2.1.2, "Safety margin," in RG 1.174, Revision 2, discusses safety margin as one of the key principles of risk-informed integrated decision-making. This Regulatory Position states, in part, that with sufficient safety margin, the safety analysis acceptance criteria in the licensing basis (e.g., final safety analysis report (FSAR), supporting analyses) are met or proposed revisions provide sufficient margin to account for analysis and data uncertainty. Section 7.5, "Defense-in-Depth and Safety Margin," of NEI 17-02, Revision 1, explains that engineering evaluation should be performed to assess whether the proposed licensing basis change maintains safety margin and identify conservatisms in the risk assessment to show that safety margin is maintained.

Section 3.2, "Traditional Engineering Considerations," of the Enclosure to the submittal discusses defense-in-depth and safety margin and states, in part, that "safety analysis acceptance criteria in the licensing basis are unaffected by the proposed change" but provides no basis for that statement.

Section 2.3, "Evaluate Target and Missile Characteristics," of NEI 17-02, Revision 1, states that tornado missile failures do not need to be considered for SSCs protected by 18-inch reinforced concrete walls, 12-inch reinforced concrete roofs, and/or 1-inch steel plate. The guidance requires no analysis for evaluating the risk of non-conforming conditions that are protected as described in Section 2.3 of NEI 17-02, Revision 1, and implies that no protection against the tornado generated missiles is needed for those SSCs. Revision 1 of NEI 17-02 provides similar guidance in Sections 5 and 6.5.

a. Describe the basis for the conclusion that the safety analysis acceptance criteria in the licensee's safety analysis are not impacted by the proposed change.

b. Discuss any non-conforming conditions that were (or if identified in the future, will be) screened from GGNS TMRE analysis using the criteria in Section 2.3 of NEI 17-02, Revision 1. For those non-conforming conditions, demonstrate that the safety analysis acceptance criteria in the licensing basis are met or that proposed revisions provide sufficient margin to account for analysis and data uncertainty.

EOI Response to RAI 13

a. The basis for concluding that the safety analysis acceptance criteria in the Grand Gulf safety analysis are not impacted by the proposed change is as follows:

   The objective for protection from tornado missiles is, if required, to bring the reactor to a safe and stable shutdown condition during or following a tornado. As stated in 10 CFR 50, Appendix A, "General Design Criteria," Criterion 2, "Design bases for protection against natural phenomena," "Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions." Unlike other design criteria, such as Criteria 17, assumption of a single failure is not required in the design to protect against natural phenomena. The safety analysis acceptance criteria described in Chapters 6 and 15 of the GGNS UFSAR are not altered by the proposed change and the acceptance criteria will continue to be met. The safety analyses do not assume a tornado occurs coincident with a design basis accident, except to the extent that a tornado may have the potential to initiate some of the design basis accidents but does not alter the response to the accident. The assumption of failure of one train of a safety system is explicit in the accident analysis. Only a very small fraction of the equipment assumed to mitigate an accident is not protected from the effects of tornado missiles. In the event exposed components of one train of safety related equipment are affected by a tornado missile, there is reasonable assurance that a separate train would be available to provide the safety function. In addition to the equipment credited in the safety analysis described in the GGNS UFSAR, on-site and near-site FLEX equipment is also available, which provides further assurance that the safety analysis acceptance criteria would be met.

b. Screening of SSCs from the list of non-conforming conditions using the statement in Section 2.3 that "tornado missile failures do not need to be considered for SSCs protected by 18-inch reinforced concrete walls, 12-inch reinforced concrete roofs, and/or 1-inch steel plate" was not performed at GGNS, although it may be used in the future. Screening of SSCs protected by reinforced concrete walls and roofs, as well as steel plate, was done in accordance with design basis requirements. Section 5 was revised and Section B.6.3 was added to Enclosure 2 to Reference 2 to provide the bases for these protective barriers.

NRC RAI 14

Regulatory Position 2.4, "Acceptance Guidelines," in RG 1.174, Revision 2, discusses the risk acceptance guidelines. Section 7.3, "Comparison to Risk Metric Thresholds," of NEI 17-02, Revision 1, indicates that the delta risk between the compliant case and the degraded case PRA results should be evaluated against the "very small" change in risk acceptance guidelines given in RG 1.174, Revision 2 (change in CDF of smaller than 10^{-6} per year and change in LERF of smaller than 10^{-7} per year), and states, in part, that:

> [i]t is possible that some licensees may exceed these thresholds, in which case, additional discussion on defense-in-depth and safety margins may be warranted in the LAR.

Section 2.5, "Quantify Risk, Perform Sensitivity Analyses, and Compare to Thresholds," of NEI 17-02, Revision 1, states, in part, that:

> [i]f ΔCDF or ΔLERF are close to or exceed the thresholds of RG 1.174, refinements to the Compliant and/or Degraded Case PRAs may be appropriate.

And

> [i]f further reductions to ΔCDF and ΔLERF are not possible [by refining the analysis], the licensee will need to decide whether physical modifications should be made and to which SSCs.

Section 7.3 of NEI 17-02, Revision 1, appears to allow providing more information about defense-in-depth if the change-in-risk thresholds of RG 1.174 are exceeded, whereas Section 2.5 appears to allow analysis refinement and plant modification if the thresholds are exceeded.

Describe the licensee's approach if performance monitoring programs indicate that the risk acceptance guidelines for "very small" change in risk in RG 1.174, Revision 2, are exceeded. Clarify whether any additional refinements beyond the guidance in NEI 17-02, Revision 1, will be made if acceptance guidelines are exceeded.

EOI Response to RAI 14

If, under performance monitoring programs, the "very small" risk change thresholds as defined in RG 1.174, Revision 3, are exceeded, additional refinements may be made to the TMRE model inputs (e.g., correlation modeling, shielding, robust missile percentages) within the constraints of the approved methodology at that time to reduce the risk change values back to acceptable levels. Other PRA model updates and refinements to the model of record that may impact the TMRE analysis but are not directly related to TMRE inputs may also be made (e.g., refined system modeling, data update, etc.) as these types of base internal events model of record changes are not governed by NEI 17-02, Revision 1.

If the apparent change in risk due to non-conformances cannot be reduced below acceptable levels through modeling updates and refinements, then GGNS will consider changes to the plant as necessary.

NRC RAI 15

Regulatory Position 3, "Element 3: Define Implementation and Monitoring Program," in RG 1.174, Revision 2, states that careful consideration should be given to implementation of the proposed change and the associated performance monitoring strategies. Section 8.1, "Plant Configuration Changes," of NEI 17-02, Revision 1, states that design control programs meeting 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," will ensure subsequent plant configuration changes are evaluated for their impact on non-conforming SSC risk using TMRE. Section 8.1 also states, in part, that:

> [l]icensees should ensure that they have sufficient mechanisms to assure that any significant changes to site missile sources, such as a new building, warehouse, or laydown area are evaluated for impact to the TMRE basis, even if not in the purview of the site Design Control program.

Section 4.1, "Applicable Regulatory Requirements/Criteria," of the Enclosure to the submittal states that the licensee has confirmed that sufficient mechanisms to assure that any significant permanent changes to site missile sources, such as a new building, warehouse, or laydown area, are evaluated for impact to the TMRE basis, even if not in the purview of the site design control program. Permanent changes that increase the site missile burden within the 2500-ft missile radius established for TMRE should be reviewed for impact on the TMRE analysis.

a. Describe the mechanism(s) and approach(es) that will be followed by the licensee to determine whether a particular change to the facility is "significant" for evaluation of the impact to the TMRE basis.

b. Describe the licensee's mechanisms that assure temporary and permanent changes to site missile sources will be evaluated.

c. Describe the process(es) that ensure changes that could affect GGNS TMRE results (e.g., plant design changes, changes made to the licensee's base internal events PRA model and new information about the tornado hazard at the plant) are considered in future implementation of the licensee's TMRE.

d. Describe, with justification, the treatment of the currently identified non-conforming conditions in future uses of the licensee's TMRE PRA model.

e. Describe, with justification, how the cumulative risk associated with unprotected SSCs evaluated under TMRE will be considered in future decision making (e.g., 10 CFR 50.59 criteria as well as in future risk-informed submittals).

EOI Response to RAI 15

a. Changes to previous non-conforming SSCs that would increase the target EEFP (e.g., effect the target exposed area by increasing the exposed exhaust pipe height, effect a robust missile percentage by changing pipe material or thickness) are not allowed under TMRE. Only changes that result in increased site missile burden require a TMRE analysis update.

   Entergy Nuclear Engineering Design procedures require the impact of design changes to be considered by various organizations, including the impact on plant risk. Individuals performing design change activities in accordance with the new Standard Design Process, IP-ENG-001, are responsible for completing an Impact review where Probabilistic Risk Assessment is a stakeholder. Impact Reviews verify affected items (procedures, equipment, programs, etc.) and interfaces have been identified. The design change Responsible Engineer is responsible for ensuring key stakeholder/impact review comments have been appropriately incorporated into the Engineering Change. A design change that affects the parameters of TMRE would have to be evaluated with TMRE prior to being implemented.

b. The new Standard Design Process, IP-ENG-001, assures permanent changes to site missile sources will be evaluated for the impact of potential missiles and the introduction of the possibility of new missiles that are not bounded by existing analyses. In accordance with Section 8.1 of NEI 17-02, Revision 1, permanent changes that increase the site missile burden within the 2500 ft. missile radius shall be included in the TMRE analysis. These changes would be captured in reviews by impacted departments. Stakeholders from other departments, areas, or programs are included in reviews of the impacts and this list includes Probabilistic Risk Assessment (PRA).

c. The process used to update the TMRE analysis will be in accordance with NEI 17-02. The Entergy Nuclear design control program will be updated to ensure subsequent plant changes that result in an increase to the site missile burden are evaluated for impact on the TMRE risk basis as described in NEI 17-02, Revision 1B (i.e., Enclosure 2 to Reference 3), Section 8.1.

d. Targets that are treated as non-conforming in the initial application of the TMRE will continue to be considered non-conforming in future revisions of the TMRE model. There may be exceptions in the following cases where the targets:

   - have been physically protected in such a way that they would no longer be considered non-conforming at the time of the revision and can be removed from the TMRE analysis, or
   - would not otherwise be considered non-conforming at the time of the revision because engineering calculations have demonstrated that they are conforming.

e. For the purpose of decision-making related to those SSCs, the change in risk calculated from the TMRE is intended to be an estimate that reasonably bounds the risk from tornado missiles due to non-conforming SSCs. Once incorporated into the license, the TMRE may continue to be used to evaluate additional non-conforming SSCs in accordance with Enclosure 2 to Reference 3 guidance.

<u>NRC RAI 16</u>

Regulatory Position 2.3.2, "Level of Detail Required to Support an Application," in RG 1.174, Revision 2, states that the level of detail required of the PRA is that which is sufficient to model the impact of the proposed change. This Regulatory Position further states that the characterization of the problem should include establishing a cause effect relationship to identify portions of the PRA affected by the issue being evaluated.

Section 6.5, "Target Impact Probability Basic Events," of NEI 17-02, Revision 1, states, in part, that:

> SSC failures from tornado missiles may need to be considered for failure modes not previously included in the internal events system models.

Section 6.5 then provides four relevant examples (i.e., flow diversion and/or leaks, tank vent failures, valve position transfer - spurious actuations, and ventilation damper failures). The section does not appear to provide guidance about when and to what extent such failure modes should be considered.

Describe how the potential failure modes stated in Section 6.5 of NEI 17-02, Revision 1, were considered by the licensee during the TMRE walkdown, identified, and included in the licensee's TMRE PRA model used to support this application.

EOI Response to RAI 16

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, . (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 17

Section 3.3, "Ex-Control Room Action Feasibility," of NEI 17-02, Revision 1, states that no credit for operator action should be taken for actions performed within 1 hour of a tornado event outside a Category I structure (in a location for which the operator must travel outside a Category I structure), but can be considered in the PRA after 1 hour. Guidance in this section states that operator actions after 1 hour could be impacted by such environmental conditions as debris that blocks access paths and should be considered by taking into account whether equipment will be accessible and whether the time required to perform the action will be impacted.

Discuss, with justification, the assessments performed to ensure that environmental conditions will not affect operator actions that are credited after 1 hour in the licensee's TMRE PRA model used to support this application.

EOI Response to RAI 17

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 18

Section 4.6, "Calculate Exceedance Probabilities," of NEI 17- 02, Revision 1, states that exceedance probabilities should be generated for "the upper ranges for each F' [Fujita prime] category," F' 2 through F' 6, using the trendline equation. The figure provided in Section 4.6 suggests that the largest exceedance probability for each F' category, which corresponds to the lowest tornado speed for each F' category, is used.

Describe how the exceedance probabilities influence on the initiating event frequencies were determined using the guidance in Section 4.6 of NEI 17-02, Revision 1 in the TMRE methodology.

EOI Response to RAI 18

The tornado initiating event frequencies were determined using the methodology described in NEI 17-02, Revision 1. The F-scale wind speed estimates for tornados of frequency 1.00E-05/yr, 1.00E-06/yr, and 1.00E-07/yr were determined from a review of NUREG/CR-4461, Revision 2. A trendline was established and the resulting equation was used to calculate a frequency for tornado wind speeds from 40 MPH to 300 MPH.

Using the F'-scale tornado intensity MPH ranges, exceedance frequencies were determined for each tornado intensity F'2 through F'6. Then, interval frequencies were developed for each range by subtracting the exceedance value of the next higher intensity from the previous intensity exceedance value. These interval frequencies were then used as the initiating event frequency.

NEI 17-02, Sections 4.3 through 4.6 were revised to clarify the process of developing a site-specific tornado hazard curve.

NRC RAI 19

Tables 2-2 and 3-3 of the Enclosure to the submittal lists the "non-conforming (safety related) SSC vulnerabilities" used for the licensee's TMRE evaluation. The list in the above-mentioned tables in the submittal does not appear to include the SSCs presented in the pre-submittal meeting slides (ADAMS Accession No. ML17283A412). One of the items listed in Section 3.2 of the Enclosure to the submittal refers to a licensee procedure that includes "post-tornado walkdowns for tornado missile vulnerable SSCs." It is further stated that the procedure "includes a table of plant vulnerabilities to tornado-generated missiles and recovery actions that reduce the impact of a tornado missile affecting the identified SSCs." Further, Attachment 1 of the Enclosure to the submittal provides the proposed changes to the licensee's Updated Final Safety Analysis Report (UFSAR) where several of the vulnerabilities that were listed in the pre-submittal meeting slides are included in the proposed revision to UFSAR Table 3.5-8 "Safety Related Components Located Outside" and are categorized using terms such as "exposed" and "partially shielded".

a. Explain, with justification, the rationale for not including several of the vulnerabilities listed in the pre-submittal meeting slides in the proposed revision to UFSAR Table 3.5-8 or Table 3.5.1-14a given that the vulnerabilities are "safety related" and found to be "exposed" and/or "partially shielded". Section 5.3.2, "Target Shielding," of NEI 17-02, Revision 1 provides guidance for partial shielding. Provide additional detail on whether partial shielding is credited in in TMRE assessment.

b. Provide a list of all non-conformances and vulnerabilities modeled in the licensee's TMRE model. Include the surface area, robust target credit, number of missiles, MIP, and EEFP for each item identified in the list and cite the source for any robust target credit used.

c. Discuss whether plant vulnerabilities identified in the table in the cited procedure were considered and included in the licensee's TMRE PRA and provide the rationale for any exclusions.

d. Provide mark-up of all UFSAR section that have proposed changes. Section 2.4 of LAR specifies changes in UFSAR Section 3.5.1.4, however Attachment 1 to LAR does not reflect any markup to that UFSAR section.

e. According to Table 3.5-8 in Attachment 1 of the Enclosure to the submittal, eighty-one (81) six-inch diameter openings exist on the north face of the Control Building exterior wall and those openings are exposed due to the partially complete Unit 2 auxiliary building. The submittal seems to be missing any discussion or screening criteria for acceptability of leaving eighty-one (81) 6-inch control room penetrations (partially exposed) unprotected. If the penetrations are included in the licensee's TMRE, describe the approach used for their modeling and inclusion. If the penetrations are not included in the licensee's TMRE, justify their exclusion.

EOI Response to RAI 19

a. The original list of vulnerabilities provided in the pre-submittal meeting was bounded in the pre-submittal results by assuming those failures only occurred in the degraded case. After the pre-submittal meeting, the walkdown information was reviewed to ascertain which of the vulnerabilities were actually non-conformances. As a result of this review, a final list of non-conformances was developed and those items that were not identified as non-conformances were treated as vulnerabilities in the final results. Below is a listing of those items from the pre-submittal meeting identified as vulnerabilities and a brief description of why these are not non-conformances.

Component	TMRE Analysis	Reference
Diesel Generator Fuel Oil Storage Tank Vents and Inlets	Only the Fuel Oil Storage Tank Vents were screened. Reason for screening, is that there is an alternate tank vent path which runs under ground to the corresponding day tanks. This alternate vent path provides a redundant vent path for the fuel oil storage tanks.	1) ENTG#GG052-TMRE-002

Component	TMRE Analysis	Reference
Control Building HVAC Outside Air Intake Louver/Damper (Penetration CV-4H)	Walkdowns determined that no safety-related SSCs or SSCs credited in the PRA are exposed to missiles through this penetration.	1) ENTG#GG052-TMRE-002
Control Building Elevator Machine Room Intake Air Damper (Penetration CV-2H)	Walkdowns determined that no safety-related SSCs or SSCs credited in the PRA are exposed to missiles through this penetration.	1) ENTG#GG052-TMRE-002
Control Building Elevator Machine Room Service Door (Door OC801)	No safety-related SSCs or SSCs credited in the PRA are exposed to missiles through this door. Therefore, this vulnerability has no impact on risk from tornado missiles. This door provides access to the roof via Stair No. OC01. Therefore, there is no equipment behind this door.	1) ENTG#GG052-TMRE-002 2) GGNS-CS-17-00002
Control Building Elevator Machine Room Exhaust Air Check Damper (Penetration CV-3H)	Walkdowns determined that no safety-related SSCs or SSCs credited in the PRA are exposed to missiles through this penetration.	1) ENTG#GG052-TMRE-002
Three (3) Cable Tray Supports at South End of Breezeway	The cables in these trays are non-safety related. These cables are not required for operation of the EDGs and are not modeled in the PRA. Based on this information, there are no missile targets that require evaluation in the TMRE assessment.	1) ENTG#GG052-TMRE-002
Control Building Lobby Door (Door OC313)	No safety-related SSCs or SSCs credited in the PRA are exposed to missiles through this door. Therefore, this vulnerability has no impact on risk from tornado missiles.	1) ENTG#GG052-TMRE-002
Stairwell door elevation 133'-0"	There is no equipment directly behind this door. Directly behind Door OCT5 is Door OCT4 which provides entry into the Control Building. Additionally, behind Door OCT4 is a corridor with a block wall at the end. Behind the block wall is Door OC305 and behind that is a hallway. Therefore, no equipment is exposed by entry of a missile through Door OCT5.	1) GNS-CS-17-00002
Six-inch diameter openings, 81, on north face of wall	This target set consists of 81 6-inch diameter penetrations through the North wall of the uncompleted Unit 2 portion of the control building. Walkdowns of the penetrations determined that only 3 of the penetrations expose Unit 1 cables to missiles. These 3 penetrations were included in the TMRE analysis as vulnerabilities.	1) ENTG#GG052-TMRE-002

No partial shielding was credited to screen any of the previously determined non-conformances. However, robust targets were credited in the EEFP calculations associated with the Diesel Fuel Oil Storage Tank Inlet Connections, the doors to cable chase room (door 1A501), and SSW Cooling Tower Basins pump house room doors.

b. **Robust Target Credit**: In the calculation of EEFP, all targets except for those listed below are conservatively considered as non-robust targets, and the total missile inventory reduction factors for robust targets in Table 7-2 of NEI 17-02, Revision 1 are not used.

- The Diesel Fuel Oil Storage Tank Inlet Connections are considered Robust targets, and a smaller number of missiles (50%) per Category F, "Steel Pipe – less than 10" diameter or 3/8" thickness", in Table 5-2 of NEI 17-02, Revision 1 are used in the TMRE analysis.

- Two cases for steel doors (Cable Chase Room (Room 1A539) Behind Door 1A501 and SSW Cooling Tower Basins (Basin "A" and "B") Pump House/Valve Room Doors) are considered to be Robust Targets and a smaller number of missiles (45%) per Category G, "Steel Doors", in Table 5-2 of NEI 17-02, Revision 1 are used in the TMRE analysis. All other doors are conservatively assumed to be non-robust targets.

Number of Missiles: The total tornado inventory at the site, bounded by a 2500' square from the center of the Power Block is 233,980 missiles. This is less than TMRE site bounding number of total tornado missiles of 240,000 from Section 5.1 of NEI 17-02, Revision 1. Therefore, it is acceptable to use the tornado missile inventory values as specified in Table 5-1 of NEI 17-02, Revision 1. The tornado inventory used in the calculation of the EEFPs at GGNS, based on Tornado Category is:

Tornado Category	Total Missile Inventory
F'2	155,000
F'3	155,000
F'4	205,000
F'5	240,000
F'6	240,000

Missile Impact Parameter (MIP): The MIP is the probability of a tornado-driven missile impact on an SSC per unit area (ft^2) of the SSC, per missile, per tornado. Table 5-1 of NEI 17-02, Revision 1 provides the generic MIP values to use in the EEFP calculation based on Tornado Category and target elevation relative to the missile source ("Near Ground" and "Elevated" targets). However, given the concerns expressed with this potential non-conservatism in the MIP estimation for near ground missiles, the near ground MIP has been increased by approximately 30%. The "Near Ground" MIP values are used for all EEFP calculations at GGNS since all the identified vulnerabilities are located in or near the Power Block Region. Additionally, the Enclosure Building Room and the Turbine Building roof are above the vulnerabilities and are sources of tornado missiles. The MIPs used in the GGNS EEFP calculations, based on Tornado Category are:

Tornado Category	**Targets <=30' Above Grade**
F'2	1.40E-10
F'3	4.60E-10
F'4	7.90E-10
F'5	2.00E-09
F'6	3.10E-09

The following table lists all Non-Conformances and Vulnerabilities modeled in the GGNS TMRE, and includes the surface area of each item and the calculated EEFPs for each item based on Tornado Category.

Item	**Description**	**Non-Conformance or Vulnerability?**	**Surface Area (sq ft)**	**Exposed Equipment Failure Probability for Tornado Category (1)**				
				F'2	**F'3**	**F'4**	**F'5**	**F'6**
1A	Diesel Fuel Oil Storage Tank Vents (Note 11)	Vulnerability	17.75	3.0E-04	9.9E-04	2.3E-03	6.8E-03	1.0E-02
1B	Diesel Fuel Oil Storage Tank Inlet (Test) Connection Pipes	Non-Conformance	0.57	6.24E-06 (Note 6)	2.04E-05 (Note 6)	4.64E-05 (Note 6)	1.37E-04 (Note 6)	2.13E-04 (Note 6)
2	SSW Cooling Tower Basin "A" & "B" Fanstacks (Note 11)	Vulnerability	537.76	1.17E-02	3.83E-02	8.65E-02	2.62E-01	4.00E-01

Item	Description	Non-Conformance or Vulnerability?	Surface Area (sq ft)	Exposed Equipment Failure Probability for Tornado Category (1)				
				F'2	F'3	F'4	F'5	F'6
3A	Straight Vertical SSW Return Lines	Non-Conformance	35.6	1.55E-03 (Note 4)	5.11E-03 (Note 4)	1.15E-02 (Note 4)	3.50E-02 (Note 4)	5.42E-02 (Note 4)
3B	"L" Shaped Vertical SSW Return Lines	Non-Conformance	42.27	1.88E-03 (Note 4)	6.13E-03 (Note 4)	1.38E-02 (Note 4)	4.00E-02 (Note 4)	6.20E-02 (Note 4)
4	Control Building HVAC Outside Air Intake Louver/Damper, Penetration CV-4H (Note 11)	Vulnerability	7.78	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
5	Control Building Elevator Machine Room Intake Air Damper, Penetration CV-2H (Note 11)	Vulnerability	7.78	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
6	Control Building Elevator Machine Room Service Door (Door OC801) (Note 11)	Vulnerability	23.3	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
7	Control Building Elevator Machine Room Exhaust Air Check Damper, Penetration CV-3H (Note 11)	Vulnerability	5.44	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
8	Eighty-one (81) 6" dia. Control Building Openings, Penetrations CE-198G through CE-278G (Note 11)	Vulnerability	0.2	1.26E-05	4.22E-05	9.40E-05	2.81E-04	4.26E-04
9	Control Building Stairwell Door (Door OCT5) (Note 11)	Vulnerability	23.3	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
10A	Diesel Generator Exhaust Pipes for Div. 3 (HPCS) (Note 11)	Vulnerability	11	2.42E-04 (Note 5)	7.79E-04 (Note 5)	1.76E-03 (Note 5)	5.25E-03 (Note 5)	8.14E-03 (Note 5)

Item	Description	Non-Conformance or Vulnerability?	Surface Area (sq ft)	Exposed Equipment Failure Probability for Tornado Category (1)				
				F'2	F'3	F'4	F'5	F'6
10B	Diesel Generator Exhaust Pipes, for Div. 1 & Div. 2 (Standby) (Note 11)	Vulnerability	28.27	6.11E-04	2.04E-03	4.64E-03	1.37E-02	2.07E-02
11	Diesel Generator Lube Oil Sump Vents (Note 11)	Vulnerability	4.19	9.04E-05	2.94E-04	6.77E-04	2.00E-03	3.10E-03
12	Diesel Generator Fuel Oil Day Tank Vents	Non-Conformance	0.81	1.78E-05	5.75E-05	1.2E-04	3.87E-04	5.94E-04
13	SSW Supply Header and Return Header (Note 12)	Non-Conformance	13.52	5.72E-05	1.88E-04	4.27E-04	1.26E-03	1.96E-03
14	Diesel Generator Building Breezeway Cable Tray Supports (Note 11)	Vulnerability	7.79	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
15	Cable Chase Room (Room 1A539) Behind Door 1A501	Non-Conformance	21.5	2.12E-04 (Note 7)	6.900E-04 (Note 7)	1.580E-03 (Note 7)	4.669E-03 (Note 7)	6.975E-03 (Note 7)
16	SSW Cooling Tower Basins (Basin "A" and "B") Pump House/Valve Room Doors (Note 11)	Vulnerability	3.71	3.608E-05 (Note 7)	1.208E-04 (Note 7)	2.709E-04 (Note 7)	7.875E-04 (Note 7)	1.221E-03 (Note 7)
17	Diesel Generator Crank Case Vents (Note 11)	Vulnerability	4.19	9.04E-05	2.94E-04	6.77E-04	2.00E-03	3.10E-03
18	Control Building Lobby Door (Door OC313) (Note 11)	Vulnerability	64.5	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
PRA-1	Fire Water Pump House (Room 0M101)	Vulnerability	2527.61	5.47E-02	1.79E-01	4.14E-01	1.00E+00	1.0E+00
PRA-2	Fire Water Pump Suction Header Cross-tie	Vulnerability	106.6	2.29E-03	7.54E-03	1.76E-02	5.12E-02	7.88E-02
PRA-3	Fire Water Pump House (Room 0M103)	Vulnerability	2838.5	5.47E-02	1.79E-01	4.14E-01	1.0E+00	1.0E+00
PRA-4A	Fire Water Storage Tank A	Vulnerability	5483.31	1.0E+00 (Note 8)	1.0E+00 (Note 8)	1.0E+00 (Note 8)	1.0E+00	1.0E+00

Item	Description	Non-Conformance or Vulnerability?	Surface Area (sq ft)	Exposed Equipment Failure Probability for Tornado Category (1)				
				F'2	F'3	F'4	F'5	F'6
PRA-4B	Fire Water Storage Tank B	Vulnerability	5483.31	1.0E+00 (Note 8)	1.0E+00 (Note 8)	1.0E+00 (Note 8)	1.0E+00	1.0E+00
PRA-5	Turbine Building Rooms 1T307 & 1T308 (El. 133'-0") (Note 10)	Vulnerability	1419	3.05E-02	1.01E-01	2.26E-01	6.75E-01	1.00E+00
PRA-6	Battery 1K3 Output Breaker Bus 11DK	Vulnerability	223.47	4.84E-03 (Note 9)	1.53E-02 (Note 9)	3.64E-02 (Note 9)	1.07E-01 (Note 9)	1.68E-01 (Note 9)
PRA-7	Station DC Power Supply 125VDC Battery 1K3	Vulnerability	737.3	1.65E-02 (Note 9)	5.24E-02 (Note 9)	1.19E-01 (Note 9)	3.50E-01 (Note 9)	5.42E-01 (Note 9)
PRA-8	Condensate Storage Tank	Vulnerability	5906.19	1.0E+00 (Note 8)	1.0E+00 (Note 8)	1.0E+00 (Note 8)	1.0E+00	1.0E+00
PRA-9	Condensate Storage Tank Supply to HPCS/RCIC	Vulnerability	1574.42	3.44E-02	1.12E-01	2.51E-01	7.50E-01	1.00E+00
PRA-10	Isolation Valve	Vulnerability	6.22	1.40E-04	4.47E-04	1.00E-03	3.000-03	4.65E-03
PRA-11	Isolation Valve	Vulnerability	5.69	1.23E-04	4.09E-04	9.28E-04	2.75E-03	4.26E-03
PRA-12	Isolation Valve	Vulnerability	5.69	1.23E-04	4.09E-04	9.28E-04	2.75E-03	4.26E-03
PRA-13	Isolation Valve	Vulnerability	4.65	1.01E-04	3.32E-04	7.52E-04	2.25E-03	3.49E-03
PRA-14	Isolation Valve	Vulnerability	5.69	1.23E-04	4.09E-04	9.28E-04	2.75E-03	4.26E-03
PRA-15	Isolation Valve	Vulnerability	8.31	1.78E-04	5.88E-04	1.38E-03	4.00E-03	6.20E-03
PRA-16	Isolation Valve	Vulnerability	8.7	1.91E-04	6.26E-04	1.38E-03	4.13E-03	6.46E-03
PRA-17	Isolation Valve	Vulnerability	5.69	1.23E-04	4.09E-04	9.28E-04	2.75E-03	4.26E-03

Item	Description	Non-Conformance or Vulnerability?	Surface Area (sq ft)	Exposed Equipment Failure Probability for Tornado Category (1)				
				F'2	F'3	F'4	F'5	F'6
PRA-18	Isolation Valve	Vulnerability	5.69	1.23E-04	4.09E-04	9.28E-04	2.75E-03	4.26E-03
PRA-19	Isolation Valve	Vulnerability	5.69	1.23E-04	4.09E-04	9.28E-04	2.75E-03	4.26E-03
PRA-20	Isolation Valve	Vulnerability	4.12	8.91E-05	2.94E-04	6.65E-04	2.00E-03	3.10E-03
PRA-21	Isolation Valve	Vulnerability	4.39	9.55E-05	3.07E-04	7.15E-04	2.13E-03	3.23E-03
PRA-22	Isolation Valve	Vulnerability	5.17	1.12E-04	3.71E-04	8.40E-04	2.50E-03	3.88E-03
PRA-23	Isolation Valve	Vulnerability	5.17	1.12E-04	3.71E-04	8.40E-04	2.50E-03	3.88E-03
PRA-24A	Air Exhaust Louvers	Vulnerability	73.12	1.2E-03	4.1E-03	9.4E-03	2.8E-02	4.2E-02
PRA-24B	Air Exhaust Louver Openings	Vulnerability	58.5	(Note 2)	(Note 2)	(Note 2)	(Note 2)	(Note 2)
PRA-25	Diesel Generator Air Intake Louvers	Vulnerability	164.44	3.56E-03	1.18E-02	2.63E-02	7.88E-02	1.23E-01
PRA-26	Containment Cooling System Exhaust Louver	Vulnerability	74.73	1.65E-03	5.37E-03	1.22E-02	3.63E-02	5.55E-02
PRA-27	Main Trip Valves	Vulnerability	Not Determined (note 11)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
PRA-28	Unit 2 Turbine Building Header Isolation Valves	Vulnerability	Not Determined (note 11)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
PRA-29	Fire Protection System Valve	Vulnerability	Not Determined (note 11)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
PRA-30	SSW INL to DG 11 Water Cooler - Loop A	Vulnerability	Not Applicable	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)
PRA-31	SSW INL to DG 12 Water Cooler - Loop B	Vulnerability	Not Applicable	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)
PRA-32	Diesel Generator 11 Cooler Outlet - Loop A	Vulnerability	Not Applicable	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)
PRA-33	Diesel Generator 12 Cooler Outlet - Loop B	Vulnerability	Not Applicable	(Note 3)	(Note 3)	(Note 3)	(Note 3)	(Note 3)

Item	Description	Non-Conformance or Vulnerability?	Surface Area (sq ft)	Exposed Equipment Failure Probability for Tornado Category (1)				
				F'2	F'3	F'4	F'5	F'6
PRA-34	ESF 11 Transformer	Vulnerability	725	1.53E-02	5.24E-02	1.18E-01	3.48E-01	5.40E-01
PRA-35	ESF 12 Transformer	Vulnerability	1950	4.23E-02	1.39E-01	3.16E-01	9.36E-01	1.0E+00

1. The EEFPs calculated are for individual pieces of equipment (individual vents, exhausts, fans, or pipes), with the exception of Item 14 (value is for all three cable tray supports given their proximity to each other).
2. The vulnerability does not expose equipment. Therefore, no EEFP has is provided for the vulnerability.
3. The SSW Supply Header and Return Header for Loop A and Loop B are located in the Breezeway far enough away from the entrance such that no line of sight exists for these headers.
4. For Item 3 Parts A & B, each loop is comprised of two (2) vertical runs. As a result, the EEFP for each loop will be twice that of each vertical run.
5. For Item 10 Part A, there are two (2) Diesel Generator Exhaust Pipes for the Div. 3 (HPCS) Diesel Generator. As a result, the EEFP for the Div. 3 (HPCS) Diesel Generator due to the exhaust vulnerability will be twice that for each exhaust pipe.
6. The EEFPs for the Diesel Fuel Oil Storage Tank Inlet Connections used in the TMRE model were adjusted to account for a smaller number of missiles (50%) per Category F in Table 5-2 of NEI 17-02. The table shows the original (non-adjusted) values.
7. The EEFPs for doors used in the TMRE model were adjusted to account for a smaller number of missiles (45%) per Category G in Table 5-2 of NEI 17-02. The table shows the original (non-adjusted) values.
8. It was determined that the CST and Fire Water Tanks design wind loading was 100 mph. Since the F'2 minimum wind speed is over 100 mph, all of the EEFPs for the tanks were set to 1.0.
9. These components are located in the turbine building. The components are well protected, but the routing of supporting electrical cables was not established. Therefore, the components are assumed not to fail in the compliant evaluation and only fail normally in the degraded mode. This is conservative because it maximizes the delta CDF between the compliant and degraded cases.
10. Valves 1N21F014A and 1N21F014B are located in the turbine building. The valves are well protected, but the routing of supporting electrical cables was not established. Therefore, the valves are assumed not to fail in the compliant evaluation and only fail normally in the degraded mode. This is conservative because it maximizes the delta CDF between the compliant and degraded cases.
11. Although this item was originally identified as being Non-Conforming, subsequent TMRE walkdowns determined that it was not non-conforming. Therefore, it has been evaluated as a vulnerability, not a non-conformance.
12. The EEFP was revised to reduce the conservatism that had been incorporated into the area considered. This EEFP represents only the area of the supply and return header.

c. GGNS procedure, 05-1-02-VI-2, "Hurricanes, Tornados and Severe Weather", contains instructions for performing 06-TE-1000-V-0001 per TRM SR 6.7.5.1 and EN-FAP-EP-010 if a tornado has occurred at the GGNS site. Procedure 05-1-02-VI-2 also includes instructions to survey the SSW Basin Area and initiate action to remove any debris that has accumulated in the fan towers, air inlets, or the SSW basin areas, and to survey the Z77, Z51, and Diesel Generator Ventilation intake structures to remove any debris. The SSW Basin, Z77, Z51, and DG Ventilation intake structures were walked down as part of the TMRE walkdowns and the identified vulnerabilities and non-conformances were included in the TMRE PRA analysis.

   Additionally, 05-1-02-VI-2 includes instructions to visually inspect the Dry Fuel Storage Area for signs of damage or debris. The Dry Fuel Storage Area is not part of the PRA, so it has not been added to the TMRE PRA analysis.

Procedure 06-TE-1000-V-0001, "Surveillance Procedure Culvert No. 1 Embankment Stability Inspection/Survey Inspection/Survey", was also reviewed. This procedure is designed to confirm the stability of the downstream access road slope and the drainage basin slope of Culvert No. 1, and a visual inspection of Culverts No. 8A, No. 9A, and No. 11. These inspections look for (1) blockage caused by sedimentation of debris, (2) slope sloughing, erosion or exposure of less wave-resistant material, and (3) cracking, heaving, lateral movement, leaking, tilting or joint misalignment of concrete structures and paved ditches. Since the culverts are not within scope of the PRA, these culverts have not been added into the TMRE PRA analysis.

Fleet procedure EN-FAP-EP-012, "Severe Weather Recovery", was also reviewed. This procedure provides guidance to Entergy Nuclear personnel during recovery efforts following severe weather or other natural events including tornados. Attachment 7.2 provides a checklist of high level actions to complete to ensure the plant can be restarted, and Attachment 7.5 provides instructions for Post Storm Walk-Downs. Within this Attachment, the following specific equipment is identified as needing to be assessed following a high winds/tornado event:

- Visual and thermography of all switchyard disconnect switches
- Visual and thermography of all switchyard insulators and line drop connections for the Main Power Transformers and offsite source transformers
- Assess potential for leaf-clogging event on intake structures due to high winds and rain
- Inspect dry cask storage casks for damaged/blocked vents
- Perform plant and outside area rounds to assess conditions
- Look for downed power lines of light poles (electrical shock hazard)
- Stability of debris on roads (personnel safety)
- Assess physical and visual conditions of buildings prior to entering the building
- Determine if electrical power is available to the buildings – record and report the loss of power if it is not available
- Identify windows or doors that are broken
- For intake structures, observe area for reptiles or other wild animals
- Determine operable condition of the equipment in the structure and record any damage noted

A review of these items identified that the switchyard switches, the transformers, and PRA-credited equipment in non-qualified structures are included, or have been added, to the TMRE PRA. Additionally, the loss of electrical power to equipment within the buildings is modeled explicitly in the TMRE PRA. The other items in the check list were reviewed and were determined to be either personnel safety type issues to address, potential to cause external flooding issues (leaf-clogging), or associated with non-PRA items (dry cask storage).

d. The Reference 1 LAR in section 2.4, "Description of the Proposed Change," subsection 2 states "Revises the GGNS UFSAR section 3.5.1.4, Missiles Generated by Natural Phenomena, to conform that section to the use of the TMRE methodology." This statement is incorrect. What subsection 2 should have stated is "...added the GGNS UFSAR section 3.5.3.3 to include the TMRE Methodology." The new section 3.5.3.3 was included in the UFSAR markup provided in Attachment 1 to the Reference 1 LAR submittal.

   Section 3.5.1.4 of the GGNS UFSAR is "Missiles Generated by Natural Phenomena". This section of the GGNS UFSAR conforms to the TMRE Methodology. The Grand Gulf missile count, as defined in LAR section 3.3.3, was performed in accordance with Section 3.4 of NEI 17-02, Revision 1, and therefore, is in full compliance with the TMRE Methodology. Therefore, no additional changes to the GGNS UFSAR are required.

e. *The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.*

NRC RAI 20

Regulatory Position 1, "A Technical Acceptable PRA," of RG 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," (ADAMS Accession No. ML090410014) addresses the technical acceptability of a PRA. Regulatory Position 2, "Consensus PRA Standards and Industry PRA Programs," further states that one acceptable approach to demonstrate conformance with Regulatory Position 1 is to use a national consensus PRA standard or standards that address the scope of the PRA used in the decision-making and that a peer review is needed to determine if the intent of the requirements in the standard is met. Regulatory Position 3.3, "Demonstration of Technical Adequacy of the PRA," in RG 1.200, Revision 2, states that one of the aspects to demonstrating the technical adequacy of the pieces of the PRA supporting an application is assurance that those pieces have been performed in a technically correct manner.

Table J.10 in Attachment L to the Enclosure to the submittal provides the finding level Facts and Observations (F&Os) from the 2015 full-scope peer-review that was performed against the 2009 version of the American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) PRA Standard.

a. Facts and Observations 5-9(F), related to SRs SC-B1 and SC-B2, notes the lack of an analytical basis for assuming successful emergency core cooling system (ECCS) pump operation with availability of suppression pool make-up (SPMU) and recommended including the assumption as a source of modeling uncertainty. The resolution of the F&O does not provide an analytical basis, but states that availability of injection from the condensate storage tank (CST) or other external source will preclude the need for SPMU and that "SPMU is determined not to be required for any additional initiators other than the previously required [medium break loss-of-coolant accident] MLOCA and [large break LOCA] LLOCA." Further, with regard to high pressure core spray (HPCS) operation, the resolution states that "injection of CST volume will increase level and the potential for trip is eliminated in the majority of cases." Section 3.3.8 of the Enclosure to the submittal states that the dominant contributor to the degraded and compliant TMRE cases was the CST. As a result, it appears that the assumption in the resolution of F&O 5-9(F) can be impacted, which in turn can impact the results of the licensee's TMRE model. In the context of the cited F&O, discuss, with justification, the impact of the dominant contribution of the CST failure in the licensee's TMRE model on this application.

Section J.4.2 of Attachment 2 to the Enclosure to the LAR states that the current GGNS internal events model-of-record (MOR), "GGNS Rev 4a PRA", includes "FLEX capabilities" and the same were added to the PRA model subsequent to the 2015 full-scope peer-review.

b. Clarify whether any FLEX equipment is modeled and credited in the TMRE PRA model used to support this application.

c. If such equipment is credited in the TMRE PRA model used to support this application,

  i. Clarify whether incorporation of mitigating strategies in GGNS internal events PRA model has been peer-reviewed. If the incorporation of mitigating strategies has not peer-reviewed, justify why the addition of mitigating strategies is not considered a PRA upgrade. If this change qualifies as an upgrade, provide the results from the focused-scope peer review including the associated F&Os and their resolution.

  ii. Identify the equipment including whether it is portable or permanently installed.

  iii. Describe, with justification, the failure rates used for each credited FLEX equipment and their associated human error probabilities (HEPs). Describe whether and how these HEPs consider environmental conditions, training and procedures relevant to this application. Alternatively, demonstrate the impact of the credited FLEX equipment on the TMRE PRA analysis using a sensitivity study that removes such credit.

  iv. Describe the approach for future use of FLEX equipment in the licensee's TMRE PRA model considering (i) the NRC staff's comments from the assessment of NEI 16-06 (ADAMS Accession No. ML17031A269) including the post-license amendment use of FLEX equipment in a PRA model, and (ii) the identification of FLEX equipment as a defense-in-depth measure in Section 3.2 of the Enclosure to the submittal.

EOI Response to RAI 20

a. The resolution of F&O 5-9(F) does not impact the GGNS TMRE analysis. The assumption in the F&O response is that adding condensate storage tank (CST) water to containment will ensure that adequate Net Positive Suction Head (NPSH) is maintained for ECCS pump suction in cases where there is no containment heat removal and containment fails or is vented. This assumption is applicable to long-term sequences.

   The dominant CST TMRE tornado failures are associated with two types of accident sequences: 1) high pressure sequences, and 2) loss of decay heat removal (including venting).

   - The high pressure sequences include failure of the reactor core isolation cooling (RCIC) and high pressure core spray (HPCS) systems along with failure to depressurize. The pump suctions for the RCIC and HPCS systems are normally aligned to the CST via a common pipe. The tank is located in an approximately 10 ft. deep, diked-in area adjacent to the auxiliary and turbine buildings. There is no tornado protection. The suctions for each pump automatically transfer to the suppression pool (SP) on low CST level or high SP level. Since the design wind loading for the CST is 100 mph and the minimum wind speed for all of the analyzed Fujita Prime categories is above that value, the CST is assumed to fail for these categories. It is also assumed that the RCIC/HPCS suction line fails because of a direct missile strike to the exposed portion of piping in the dike or due to clogging from debris associated with the CST failure. Therefore, both HPCS and RCIC are assumed to fail on the loss of suction and there is no water injection to the vessel.

   - The loss of decay heat removal sequences include failure of HPCS, decay heat removal (SP cooling and containment spray) and containment venting. In these sequences, HPCS is failed on loss of suction from the CST. The decay heat removal systems fail because of hardware failures in the residual heat removal (RHR), system standby service water (SSW), emergency diesel generators or tornado missiles that fail the SSW or the emergency diesels.

   If the HPCS suction successfully transfers to the SP following the CST failure in both accident sequence groups, the sequences may still result in core damage. This is because HPCS will fail on loss of adequate NPSH following containment failure and the subsequent SP boil-off with no external water addition.

   Since the CST and the exposed RCIC/HPCS suction pipe are not safety related, these failures and their corresponding cut sets occur in both the compliant and degraded cases. Even if the above conservative assumptions related to the CST were refined, there would be no impact on the TMRE delta CDF/LERF results since the changes would apply to both the compliant and degraded cases.

b. *The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.*

c. *The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.*

NRC RAI 21

Regulatory Position 1 of RG 1.200, Revision 2, addresses the technical acceptability of a PRA. Regulatory Position 2 further states that one acceptable approach to demonstrate conformance with regulatory position 1 is to use a national consensus PRA standard or standards that address the scope of the PRA used in the decision-making and that a peer review is needed to determine if the intent of the requirements in the standard is met.

Table J.9 of Attachment 2 to the Enclosure to the LAR provides the licensee's evaluation of specific SRs from the ASME/ANS PRA Standard that have been identified in the NEI 17-02. Additional comments from the licensee on SRs QU-E2 and QU-E4 refer to Section 3 of the Enclosure to the LAR.

Table J.10 provides the finding level F&Os from the 2015 peer-review of the licensee's internal events and internal flooding PRA models. Facts and Observations 5-22 (F) related to SR LE-G5 states that the analysis should "identify how any simplifying assumptions can impact applications."

Discuss the examination performed to identify how the simplifying assumptions for the LERF analysis impact the base internal events PRA model, as stated in F&O 5-22, as well as this application.

EOI Response to RAI 21

The simplifying assumptions identified for the LERF analysis, as documented in Section 1.6 of PSA-GGNS-01-LE, and their potential impact on the TMRE application are discussed below.

- **The GGNS MOR is developed for modeling full power operation.** – The TMRE analysis also assumes that the plant is at power when the tornado occurs. Since Figure 2-1 of the TMRE guidance document, NEI 17-02, Revision 1, specifically states that the TMRE PRA model is based on the Full Power Internal Events PRA, the assumption that the plant is at full power is consistent with the TMRE guidance.

- **The hydrogen concentration following a core melt event can vary significantly depending on the accident progression path and level of core damage. The generation of hydrogen is not evaluated in detail but is assumed to be at the**

level where hydrogen igniters are required. – Once core damage occurs, hydrogen will start to be generated. Although the timing of the hydrogen concentration buildup could be impacted by the tornado initiating event which results in a LOOP and the accident progression path resulting in the core damage, the assumption that the hydrogen igniters will be required is reasonable. There is an operator action associated with turning on the hydrogen igniters, E61-XHE-FO-MSH13. This action is performed from the main control room, which is a Category I structure. Therefore, this action would not be impacted by the tornado and the timing of the hydrogen concentration buildup would not impact the results and insights associated with either the base model or the TMRE analysis.

- **The containment is assumed to fail when pressure reaches 65 psig and drywell is assumed to fail at 85 psid.** - These are the design pressures for the containment and drywell. Without an analysis showing that they can withstand larger pressures, assuming they fail at their design pressures is a valid assumption for both the base model and the TMRE.

- **Due to uncertainties related to the overpressure processes and the expected higher pressure in the containment, an overpressure failure of the drywell due to phenomenological challenges (HPME, DCH, hydrogen burning, pedestal failure) is considered to result in a direct failure of the containment.** - Although an overpressure failure of the drywell due to phenomenological challenges could potentially occur without a subsequent failure of the containment occurring, since the design pressures are 65 psig for the Containment and 85 psid for the Drywell, it is very unlikely that the Containment would not be challenged by the drywell overpressure event. Additionally, the Containment is a Category I structure that will not be impacted due to the tornado. With both of these considerations, assuming the Containment fails when the drywell fails due to over pressure is a reasonable assumption for both the base model and the TMRE.

- **The LPCI injection line containment isolation valves are normally closed but are assumed to open if the reactor is depressurized in order to support low pressure injection. This results in these valves needing to be manually closed when LPCI is not injecting.** - The LERF model identifies those core damage sequences that demanded LPCI and assumes that the accident sequences will also require an operator action to close the LPCI injection line valves to prevent a release. For the TMRE analysis, it was also necessary to validate that the operator action to close the LPCI injection line valves would not be impacted by the presence of a tornado. The Operator action associated with the closure of the LPCI injection line valves, E12-XHE-FO-ISLLP, is performed from the Main Control Room. Since the Main Control Room is in a Category I Structure, this operator action would not be impacted by the tornado. Therefore, this assumption remains valid for the TMRE.

NRC RAI 22

The licensee's evaluation of SR AS-A10 in Table J.9 of Attachment 2 to the Enclosure to the submittal states that the diesel-driven firewater pumps are credited in the TMRE PRA model. Based on the licensee's evaluation of SR AS-B3 in the same table, it appears that the diesel-driven firewater pumps are not located in a Category I structure. Several SRs with unique TMRE considerations require inclusion of the impacts on tornado events on the system operability and success criteria (e.g. SRs AS-A3 through AS-A5, AS-B3, and SY-A4). Section 3.2.3 of NEI 17-02, Revision 1, provides guidance on such considerations during the walkdown. Sections 6.3 and 6.6 in NEI 17-02, Revision 1, provide guidance on the model changes needed to account for non-Category I structures and non-safety related SSCs therein. Section 3.3 of NEI 17-02, Revision 1, provides guidance on the feasibility of human actions outside of Category I structures. In light of the above,

a. Describe how the guidance in NEI 17-02, Revision 1, was implemented for the inclusion and credit for the diesel-driven firewater pumps in the TMRE PRA including details from the corresponding walkdown.

b. Clarify whether any operator actions are necessary and have been modeled for the diesel-driven firewater pumps. If such actions have been modeled, describe how the guidance in NEI 17-02, Revision 1, and unique TMRE considerations for the human reliability analysis (HRA) related SRs were implemented for those actions.

EOI Response to RAI 22

a. The diesel driven fire pumps are located in a non-Category I structure and could be impacted by the tornado. As a result of the walkdowns, it was noted that all the equipment is spread throughout the rooms; therefore, a conservative assumption was made to use the surface area of the rooms to calculate the EEFPs. The PRA model was then modified to include new logic associated with the failure of the diesel driven fire water pump during tornado conditions. Additionally, it was determined that the CST and Fire Water Tanks design wind loading was 100 mph. Since the F'2 minimum wind speed is over 100 mph, all of the EEFPs for the tanks are set to 1.0. These tank failures prevent the Fire Water system from having a suction source and prevent the Fire Water system from being credited in the TMRE model for all tornado categories.

b. While there are operator actions included in the TMRE PRA logic that are associated with using Fire Water as an injection source, these operator actions do not provide a success path for utilization of the Fire Water system due to the assumed failure of the Fire Water System in the TMRE analysis.

NRC RAI 23

Regulatory Position 1 of RG 1.200, Revision 2, addresses the technical acceptability of a PRA and Regulatory Position 1.1 states that the scope of a PRA is defined by the challenges included in the analysis and the level of analysis performed. Regulatory Position 3.2 of RG 1.200, Revision 2, states that the licensee needs to identify the pieces of the PRA for each hazard group required to support a specific application. Based on Attachment 2 to the Enclosure it appears that the licensee's internal events PRA model, which is the base for the TMRE PRA model, includes multiple loss-of-offsite power (LOOP or LOSP) initiators. Examples include "transient LOOP", "consequential" LOOP "as a result of transient initiator", and "loss of preferred offsite initiator."

a. Identify the different LOOP initiators in the licensee's internal events PRA model and clarify which LOOP initiator(s) was considered for the licensee's TMRE PRA model.

b. Clarify which LOOP initiator was used to develop licensee's TMRE PRA model and justify use of the selected LOOP initiator. An ideal response will discuss whether all LOOP initiators in the licensee's internal events PRA model have the same event tree, credit the same systems for mitigation and the differences between LOOP initiators.

EOI Response to RAI 23

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 24

Regulatory Position 2 in RG 1.174, Revision 2, states that the licensee should appropriately consider uncertainty in the analysis and interpretation of findings. Regulatory Position 3 states that decisions concerning the implementation of licensing basis changes should be made after considering the uncertainty associated with the results of the traditional and probabilistic engineering evaluations.

Regulatory Position 3 in RG 1.174, Revision 2, states that careful consideration should be given to implementation of the proposed change and the associated performance monitoring strategies. This Regulatory Position further states that an implementation and monitoring plan should be developed to ensure that the engineering evaluation conducted to examine the impact of the proposed changes continues to reflect the actual reliability and availability of SSCs that have been evaluated. This will ensure that the conclusions that have been drawn from the evaluation remain valid.

Section 7.2, "Sensitivity Analysis," of NEI 17-02, Revision 1, address the steps that should be taken if the change in CDF and LERF from the sensitivity analyses exceed 10^{-6} per year and 10^{-7} per year, respectively.

a. Describe the GGNS process if change-in-risk estimates from sensitivity analyses exceed the RG 1.174, Revision 2, acceptance guidelines for "very small" change in risk in implementation of TMRE methodology.

b. Describe how the importance measures are determined from the TMRE PRA model in the context of the 'binning' approach for the tornado categories employed in the model. Describe whether and how the same basic events, which were discretized by binning during the development of the TMRE PRA model, are combined to develop representative importance measures. For same basic events that are not combined, provide a justification that includes discussion of any impact on the results.

c. Identify the non-conforming conditions and vulnerabilities that met all the characteristics of a "highly exposed" SSC per Section 7.2.1, "TMRE Sensitivities," of NEI 17-02, Revision 1.

The discussions in Section 7.2 of NEI 17-02, Revision 1, do not address whether sensitivity analyses will be aggregated in future implementations of the TMRE methodology. For example, it is unclear whether the licensee will combine the sensitivity analyses related to any future open PRA facts and observations (F&Os), sensitivities that address compliant case conservatism and TMRE sensitivity analyses.

d. Describe, with justification, whether sensitivity analyses in NEI 17-02, Revision 1, will be aggregated in future implementation of the TMRE methodology.

The discussion in Section 7.2.3, "Compliant Case Conservatisms," and Section A.2.1.3, "Non-Category I Structures and Exposed Non-Safety Related SSCs," of NEI 17-02, Revision 1, recognizes that the TMRE PRA could produce non-conservative change-in-risk results if conservatively assumed failures in the Compliant Case mask change-in-risk. Accordingly, Section 7.2.3 of NEI 17-02, Revision 1, states, in part, that:

> [the] licensee should review cut sets in the top 90% of the TMRE compliant case to identify conservatisms related to equipment failure (opposed to offsite power recovery or operator actions) that could impact results.

Section 7.2.3 of NEI 17-02, Revision 1, also explains that the licensee should perform sensitivity studies associated with these conservatisms as directed in Appendix D of the TMRE guideline for PRA standard supporting requirements (SRs) AS-A10, LE-C3, and SY-B7 to address equipment failures in the compliant case that may be masking change-in-risk but does not provide guidance on how such a sensitivity can be performed.

Section 3.3.10 "Sensitivities and Uncertainties", of the Enclosure to the submittal describes a sensitivity assessment performed to ensure conservative modeling treatments in the compliant case do not affect the risk assessment conclusions.

e. Describe any future sensitivity analysis that will be performed to assess the impact of conservatisms associated with modeling the equipment failures in the compliant case of the TMRE PRA model.

Modeling operator actions, could contribute to underestimating the change-in-risk calculation associated with non-conforming SSCs. Appendix D, "Technical Basis for TMRE Methodology," of NEI 17-02, Revision 1, does not appear to address the concern described above could also apply to conservative human reliability analysis modeling (e.g., SR HR-G3 and HR-G7).

f. Describe how GGNS will address the potential impact of TMRE assumptions related to certain human error probabilities within 1 hour after the accident on the compliant case.

<u>EOI Response to RAI 24</u>

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

<u>NRC RAI 25</u>

Regulatory Position 2 in RG 1.174, Revision 2, states that the licensee should appropriately consider uncertainty in the analysis and interpretation of findings. Regulatory Position 3 states that decisions concerning the implementation of licensing basis changes should be made after considering the uncertainty associated with the results of the traditional and probabilistic engineering evaluations.

The discussion in Section A.7, "Zonal vs. Uniform (Z vs U) Sensitivity," of Appendix A, "Technical Basis for TMRE Methodology," to NEI 17-02, Revision 1, recognizes differences between zonal and uniform missile distributions without justification. Targets were categorized in Appendix A to separate intuitive from non-intuitive trends and an adjustment factor is proposed to account for zonal distribution of missiles.

Describe, with justification, how uncertainties associated with the impact of the missile distribution on the licensee's target hit probability are handled in the GGNS TMRE methodology.

<u>EOI Response to RAI 25</u>

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 26

Regulatory Position 1 of RG 1.200, Revision 2, addresses the technical acceptability of a PRA. Regulatory Position 2 further states that one acceptable approach to demonstrate conformance with regulatory position 1 is to use a national consensus PRA standard or standards that address the scope of the PRA used in the decision-making and that a peer review is needed to determine if the intent of the requirements in the standard is met.

Section 3.3.7, "Model Quantification," of the Enclosure to the submittal provides the quantification results for the licensee's TMRE model and discusses the truncation used for the model quantification. Comparison against corresponding values provided in the pre-submittal meeting slides (ADAMS Accession No. ML17283A412) shows a marked difference in the 'compliant case' results.

The truncation used for the licensee's TMRE model quantification is stated to be "consistent with the GGNS base model." However, the licensee's TMRE model quantification results are substantially lower than the base internal events model. Use of an inappropriate truncation level can adversely impact the risk insights and quantification. Supporting requirement QU-B3 in the 2009 ASME/ANS PRA Standard provides the requirements for truncation limits and provides an example of sufficient convergence as being when successive reductions in truncation value of one decade result in decreasing changes in CDF or LERF, and the final change is less than 5 percent.

Section 3.3.8 "Results", of the Enclosure to the submittal provides a discussion of the results and states that the dominant contributor for the 'compliant' and 'degraded' cases is the CST. However, the CST does not appear in Tables 2-2 and 3-3 of the Enclosure to the submittal which list the non-conformances included in the licensee's TMRE evaluation.

a. Justify the truncation level used for the licensee's TMRE model quantification and explain how the selected truncation level meets the SRs, such as QU-B3 and QU-F2, in Part 2 of the ASME/ANS PRA Standard as endorsed by RG 1.200, Revision 2.

b. Explain, with justification, the change in the quantification of the licensee's TMRE model presented in Table 3-4 of the Enclosure to the LAR, especially the change in the 'compliant' case, as compared to that provided in the pre-submittal meeting slides.

c. Explain the rationale for the CST being a dominant contributor to the risk based on the licensee's TMRE model considering that CST is not identified as a vulnerability or non-conforming condition.

EOI Response to RAI 26

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 27

Section 7.2.1, TMRE Sensitivities," of NEI 17-02, Revision 1, identifies certain sensitivity studies and provides guidance on their performance. Section 3.3.10, "Sensitivities and Uncertainties," of the Enclosure to the submittal describes the sensitivity studies performed by the licensee to support this application. It appears that the sensitivity studies in Section 3.3.10 of the Enclosure to the submittal were performed by multiplying both the compliant and degraded case which will impact the vulnerabilities in both cases. The guidance provided in Section A.6.2 of Appendix A of NEI 17-02, Revision 1, states that "the sensitivity will be performed by recalculating target EEFPs by multiplying the nominal values calculated for the Degraded Case". Similarly, the procedure for performing the sensitivities in Section 7.2.1 of NEI 17-02, Revision 1, states that "[f]or SSCs with a tornado missile failure basic event...multiply the basic event failure probability".

a. Describe the implementation of the guidance in NEI 17-02, Revision 1, on vulnerabilities when performing sensitivity analyses, especially the zonal versus uniform missile distribution sensitivity ("Sensitivity 1") and the missile impact parameter sensitivity ("Sensitivity 2"). If applicable, describe and provide the results of any updated sensitivity analyses considering the response to separate information requests on the basis for the MIP and the sensitivities (information requests 1, 4, and 24).

b. Describe the implementation of the guidance in NEI 17-02, Revision 1, on vulnerabilities when performing sensitivity analyses in future use of the licensee's TMRE PRA model.

EOI Response to RAI 27

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

NRC RAI 28

Section 3.3.2, "Assessment of Assumptions and Approximations," of RG 1.200, Revision 2, states, in part, that:

> [f]or each application that calls upon this regulatory guide, the applicant identifies the key assumptions and approximations relevant to that application. This will be used to identify sensitivity studies as input to the decision making associated with the application.

Further, Section 4.2, "Licensee Submittal Documentation," of RG 1.200, Revision 2, states, in part, that:

> [t]hese assessments provide information to the NRC staff in their determination of whether the use of these assumptions and approximations is appropriate for the application, or whether sensitivity studies performed to support the decision are appropriate.

RG 1.200, Revision 2, defines the terms "key assumption" and "key source of uncertainty" in Section 3.3.2, "Assessment of Assumptions and Approximations."

Section J5 of Attachment J of the Enclosure to the submittal states, in part, that assumptions and approximations used in the development of the GGNS internal events PRA which forms the basis for the TMRE PRA "have been reviewed and are appropriate for this application". The submittal does not appear to describe the key assumptions and key sources of uncertainties that were identified in GGNS internal events PRA model and how those assumptions and uncertainties were addressed.

a. Describe the key assumptions and key sources of uncertainties in GGNS internal events PRA that may impact this application.

b. Describe how each key assumption and key source of uncertainty was dispositioned for this application.

EOI Response to RAI 28

The answer to this RAI is based on the GGNS PRA model, which Entergy Operations, Inc. (EOI) is currently updating. The answer to this RAI will be provided in a supplemental RAI response, which will be submitted to the NRC in early 1Q19.

3. REFERENCES

1) EOI letter to NRC, "License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis," dated November 3, 2017 (ML17307A440)

2) SNC letter to NRC, "SNC Response to NRC Request for Additional Information," dated July 26, 2018 (ML18207A876)

3) Duke Energy letter to NRC, "License Amendment Request to Incorporate Tornado Missile Risk Evaluator into Licensing Basis – Supplement and Request for Additional Information Response (EPID L-2017-LLA-0355)," dated September 19, 2018 ML18262A328