NRR-DMPSPEm Resource

From: Mahoney, Michael
Sent: Friday, May 18, 2018 9:07 AM
To: 'Hentz, Lee A'
Cc: Hutchison, Bill 'Hutch'; Jeff Thomas (Jeff.Thomas@duke-energy.com)
Subject: Request for Additional Information - McGuire Nuclear Station, Units 1 and 2 - TORMIS LAR (EPID L-2017-LLA-0412)

Lee

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated December 8, 2017 (Agencywide Documents Access Management System (ADAMS) Accession No. ML17352A364), Duke Energy, (the licensee), requested changes to the McGuire Nuclear Station, Units 1 and 2 (McGuire) Updated Final Safety Analysis Report (UFSAR). The proposed amendment will revise the McGuire licensing bases for protection from tornado-generated missiles.

The NRC requires that nuclear power plants be designed to withstand the effects of tornado and high-wind-generated missiles so as not to adversely impact the health and safety of the public in accordance with the requirements of General Design Criterion (GDC) 2, "Design Bases for Protection against Natural Phenomena," and GDC 4, "Environmental and Dynamic Effects Design Bases," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities."

The safety evaluation report (SER) approving the TORMIS methodology dated October 26, 1983 (ADAMS Accession No. ML080870291) requires licensees using the methodology to consider and address five points in their applications.

In accordance with Regulatory Issue Summary (RIS) 2008-14 dated June 16, 2008 (ADAMS Accession No. ML080230578), the TORMIS methodology is an NRC-approved method for addressing identified deficiencies in complying with a plant's current licensing basis for tornado missile protection. It provides licensees the option of revising the plant's licensing basis for tornado missile protection from a purely deterministic methodology to one that includes limited use of a probabilistic approach. In RIS 2008-14, the TORMIS methodology is approved for situations where (1) a licensee identifies existing plant structures, systems, and components (SSCs) that do not comply with the current licensing basis for positive tornado missile protection of the plant and (2) it would require costly modifications to bring the plant into compliance with the current licensing basis.

The NRC staff has reviewed the application and, based upon this review, determined that additional information is needed to complete our review. Please provide a response on the docket within 45 days of this correspondence.

Request for Additional Information (RAI)-01

The proposed UFSAR, Section 3.5.2.8 markup included in Enclosure 2 does not appear to be consistent with current UFSAR Section 3.3.

The proposed UFSAR, Section 3.5.2.8 markup states:

> "Table 3-8 provides a summary of the design basis tornado-generated missiles. The integrity of all Category 1 structures is not impaired by these missiles. This is accomplished either deterministically by designing the exposed structure of steel reinforced concrete capable of withstanding the impact of

tornado-generated missiles, or probabilistically by showing that the structure will not be impacted or will not be damaged beyond an acceptable criteria if impacted as discussed in Section 3.5.2.8.1.3"

Current UFSAR Section 3.3 states, "All Category 1 structures, except those structures not exposed to wind, are designed for tornado wind loads."

The proposed UFSAR Section 3.5.2.8 markup seems to imply that some Category 1 structures are not deterministically designed to withstand missiles, which appears to be at inconsistent with current UFSAR, Section 3.3.

The NRC staff requests the licensee to clarify the application of the proposed USFAR, Section 3.5.2.8 markup with respect to Category 1 structures.

RIS 2008-14 states:

> The TORMIS methodology is not currently approved for the following:
>
> - Justifying not providing positive tornado missile protection (i.e., barrier) for plant modifications
> - removing existing tornado missile barriers
> - eliminating or relaxing of TS [Technical Specifications] requirements that have been established for tornado missile barriers and safety-related equipment
> - promoting operational flexibility or convenience

The current wording in the proposed UFSAR, Section 3.5.2.8 markups stating, in part, "… accomplished **either deterministically** by designing the exposed structure of steel reinforced concrete capable of withstanding the impact of tornado-generated missiles, **or probabilistically** by showing that the structure will not be impacted or will not be damaged beyond an acceptable criteria… " appears to support such applications of the future use of TORMIS.

The NRC staff requests the licensee to clarify its application of proposed UFSAR, Section 3.5.2.8, with regard to future use of TORMIS.

RAI-02

The LAR provides discussion on each of the five attributes of TORMIS SER. One of the five review points in the TORMIS SER specifies users should provide sufficient information to justify the assumed missile density based on site specific missile sources and dominant tornado paths of travel.

The LAR includes a brief statement on page 18, "The plant site is described by specifying the geometry, location, and material properties of the structures/components and the location of potential missile sources. Missile sources (buildings, houses, storage areas, vehicles, etc.) are modeled to a distance of approximately 2,500 feet. This process includes the development of missile origin zones around the plant and surveying the types and quantities of missiles in each zone."

The LAR neglects potential shielding effects by stating in Enclosure 1, page 14, "In TORMIS, the effects of local obstructions, buildings, and structures are neglected in simulating the tornado winds. Thus, for example, tornado winds flow through the Turbine Building without consideration of either terrain/site roughness or blockage/interference of the reinforced concrete and heavy steel frame structures."

Bases on its review of the submittal, the NRC staff is unable to locate details or layouts of the development missile origin zones depicting the type, quantity or density of missile in each zone. The LAR also does not

appear to include list of targets, shields and buildings (missile source), which are typically provided in TORMIS submittals. In addition, it is unclear what buildings are used for deconstruction to derive 214,000 missiles.

Therefore, the NRC staff requests the licensee to justify how the TORMIS SER was met and provide details of the assumed missile density based on location-specific missile counts and provide the list of targets, shields and buildings (missile source) used in the analysis.

RAI-03

The LAR references RIS 2008-14, which includes reference to the TORMIS SER. RIS 2008-14 specifically identified items licensees should address to confirm the TORMIS methodology and computer code have been applied and implemented properly.

RIS 2008-14, Item 1, advises the licensee to provide “adequate justification that the analysis used the most conservative value for tornado frequency”

The site specific analysis for development of the tornado hazard curve for McGuire is based on data from the National Oceanic and Atmospheric Administration (NOAA) Storm Prediction Center. As shown in Figure 3-2 of the submittal, the TORMIS developed McGuire tornado hazard curves, i.e., the TORRISK 200 x 200 curve, are used and compared to NUREG/CR-4461, Revision 2, “Tornado Climatology of the Contiguous United States” (ADAMS Accession No. ML070810400), to demonstrate conservatism. However, in Enclosure 1, page 21 of the LAR, it states “It can be seen that the NUREG EF [Enhanced Fujita] curve is below the TORRISK 200 x 200 curve until 180 mph, where they intersect.” As such, tornado frequency shown in the tornado hazard curve appears non-conservative beyond 180 miles per hour (mph).

The NRC staff requests the licensee to confirm that values used above 180 mph are conservative and bounding values and provide justification.

RAI-04:

One of the five review items in the TORMIS SER is to justify any deviation from the calculation approach. In addition, RIS 2008-14 (Item 2.d) includes the concern with taking credit for non-structural members. The unique McGuire configuration of the safety-related targets within the doghouses necessitated the use of the TORMIS ricochet routine to ensure conservatism in the TORMIS analysis. The doghouse openings contain non safety-related barriers (utility port barriers (UPBs)) to protect internal components from missiles. The UPBs consist of vertical and horizontal 5/8 inch diameter (No. 5) rebar spaced at five inches to six inches, on center. They are welded together at rebar intersection points and are welded to a structural steel angle frame which is either anchor bolted to doghouse concrete or welded to steel plates embedded in the doghouse concrete. As specified in the LAR, these UPBs in the openings at the top of the McGuire doghouses are credited for their ability to resist or slow down missiles impacting them. UFSAR, Chapter 3, Table 3-8 describes velocity values for tornado missiles.

As indicated in LAR, missile ricochet has been an option in the TORMIS computer code dating back to Electric Power Research Institute (EPRI) NP-769, “Tornado Missile Risk Analysis – Appendixes” dated May 1978, however, it has not previously been used in a TORMIS analysis supporting an LAR. To accomplish modeling of barriers, the ricochet routine within the TORMIS software was modified to include a missile-pass-through option to credit the barrier. The LAR states on page 7, “The original TORMIS missile ricochet routine (References 3 and 4) redirects missiles that impact rigid surfaces with a reduced velocity.” RIS 2008-14 (Item 2.d) raises a concern about taking credit for non-structural members, and the UPBs used for the dog house design appear to be non-structural.

The NRC staff requests the licensee to clarify if the ricochet model showing a reduced impact velocity is intended to mitigate the concern about crediting non-structural members, and discuss how the UPB can withstand the reduced velocity. Also explain the meaning of the missile velocities in USFAR, Table 3-8 with respect to the reduced velocity.

RAI-05

The LAR, Enclosure 1, page 8 states: "Target missile hit frequencies are the frequency of at least one tornado missile hitting a target over a period of one year. For very large targets, tornado generated missiles are likely to hit the target for almost every tornado strike and hence the missile hit frequency may approach or be essentially equal to the tornado strike frequency for such targets. As the target size reduces, as the target is shielded by other structures, or if only one surface of the target is exposed, the missile hit frequency reduces accordingly. In general, tornado missile hit frequencies are dependent on many geometrical factors as well as missile types, numbers, and proximity. The degree to which the elevation of the target is above the elevation of the nearby missile sources can also be a critical factor."

The frequencies presented in Enclosure 1, Table 3-2 of the LAR represent the average frequency produced over 60 replications representing all outage and non-outage conditions modeled. According to that table, the four targets with the highest hit frequencies are the VC/YC (Control Room Area Ventilation) Air Intakes (targets 82-85) located outside of the doghouses next to the Reactor Buildings.

The NRC staff requests the licensee to provide additional information on the "geometrical factors, missile types, numbers, proximity" etc., which explains this result.

RAI-06

NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 3, Sections 3.5.1.4 and 3.5.2, contain the current acceptance criteria governing tornado missile protection. These criteria generally specify that SSCs that are important to safety be provided with sufficient, positive tornado missile protection (i.e., barriers) to withstand the maximum credible tornado threat. SRP, Chapter 3, Section 3.5.1.4 permits relaxation of the above deterministic criteria if it can be demonstrated that the probability of damage to unprotected essential safety-related features is sufficiently small.

RIS 2008-14 describes identified items that licensees should address when performing an approved TORMIS methodology per the TORMIS SER. The SER found that once the EPRI methodology has been chosen, justification should be provided for any deviations from the calculational approach. Enclosure 1, Section 3.2 of the LAR describes how the licensee complies with the TORMIS SER criteria. Enclosure 1, Section 3.1.5, page 11 of the LAR states "Boolean logic is applied to targets to account for redundancy in the structural or system design or TORMIS modeling of a component as multiple targets."

Enclosure 1, Section 3.1.5, page 11 of the LAR states "… the Unit can sustain damage to one Main steam line, and it can be in multiple places (PORVs [power operated relief valves], MSSVs [main steam safety valves], or associated components) on the same Main steam line." Proposed USFAR changes in Enclosure 2, Section 3.5.2.8.1.3d states "[t]he failure logic for redundancy of the MainSteam lines when missile damage to the PORVs and MSSVs is beyond acceptable criteria, is that the Unit can sustain damage to one of four MainSteam line and the damage can be in multiple places on the same MainSteam line (PORVs, MSSVs, or associated components)." The basis for failure criteria is unclear. The NRC staff requests the following:

a. Describe the basis for all failure criteria used in the McGuire TORMIS analysis where Boolean logic is used. Examples include failure criteria for main steam line and PORVs or the failure criteria for Control Room Area Ventilation (VC/YC) air intakes and spent fuel pools (SFPs).

b. Considering that the criteria in SRP, Section 3.5.1.4 is compared against the probability per year of damage to all SSCs important to safety that are not designed to withstand tornado missile damage, justify comparing McGuire results using selected failure criteria against the criteria in UFSAR and SRP. Also, describe how the use of failure criteria is consistent with the application of the approved TORMIS methodology.

Enclosure 1, Section 3.1.5, page 13 of the LAR states “The Boolean logic for the Unit 1 and 2 Spent Fuel Pools and the Unit 1 and 2 VC/YC Air Intakes is that failure is defined as both VC/YC Air Intakes failing by wind missile and missile damage to fuel assemblies in either of the Spent Fuel Pools.” Proposed USFAR changes in Enclosure 2, Section 3.5.2.8.1.3d states “The failure logic for the Control Room Air Ventilation System (CRAVS) Intakes (VC/YC Air Intakes and Spent Fuel Pools (SFP) is simultaneous tornado generated missile impacts to all the Unit 1 and Unit 2 VC/YC Air Intakes AND the entry of a tornado generated missile into either the Unit 1 or Unit 2 SFP that would impact and Spent Fuel assemblies above acceptable critical velocities.” The NRC staff requests the following:

c. Define acceptable critical velocities, their basis, and their effect on SSCs.

The overall damage probability Boolean logic in Enclosure 1, Page 13 of the submittal seems to define the failure criteria as a single Unit 1 and a single Unit 2 VC/YC Air Intake Failure and a failure of either SFP results in damage, but the text on Enclosure 2, Page 8 seems to differ from the Boolean logic shown. The NRC staff requests the following:

d. Clarify the failure criteria for VC/YC air intakes and SFPs and address any discrepancies between the failure criteria in Enclosure 1, Page 13 and Enclosure 2, Page 8.

e. The individual target damage frequencies for VC/YC air intakes and SFPs in Enclosure 1, Table 3-2 do not seem to result in the value given in Enclosure 1, Page 13. Provide details on how the damage frequency for this event was derived, and explain the apparent discrepancy between Table 3-2 and Enclosure 1.

Once this email is added to ADAMS, I will provide the accession number for your reference.

Thanks
Mike

Michael Mahoney
McGuire and Catawba Project Manager, Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Desk: (301)-415-3867
Email: Michael.Mahoney@NRC.GOV

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From: Mahoney, Michael

Created By: Michael.Mahoney@nrc.gov

Recipients:
"Hutchison, Bill 'Hutch'" <Bill.Hutchison@duke-energy.com>
Tracking Status: None
"Jeff Thomas (Jeff.Thomas@duke-energy.com)" <Jeff.Thomas@duke-energy.com>
Tracking Status: None
"'Hentz, Lee A'" <Lee.Hentz@duke-energy.com>
Tracking Status: None

Post Office: BN7PR09MB2802.namprd09.prod.outlook.com

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