NRR-PMDAPEm Resource

From: Wiebe, Joel
Sent: Thursday, January 19, 2017 10:59 AM
To: Joseph Bauer
Subject: Preliminary RAIs for Byron Station TORMIS License Application Request

The purpose of preliminary RAIs is to ensure the RAIs are clear and understandable. The NRC staff requests a teleconference to discuss the RAIs within two weeks of this e-mail. Let me know when you are ready to discuss the RAIs.

In reviewing the Exelon Generation Company, LLC (Exelon's) submittal dated October 7, 2016, related to use of the TORMIS methodology for the Byron Station (Byron), Unit Nos. 1 and 2, the NRC staff has determined that the following information is needed in order to complete its review:

RAI 1 (DSS): The licensee's LAR references Regulatory Information Summary (RIS) 2008-14, "Use of the TORMIS Computer Code for Assessment of Tornado Missile Protection," which includes reference to the 1983 TORMIS safety evaluation report (SER) (ADAMS Accession No. ML080870291). One of the five review points in the TORMIS SER describes that tornado characteristics should be employed for both broad regions and small areas around the site and most conservative values used. Based on tornado occurrence information in Byron Updated Final Safety Analysis Report (UFSAR) Section 2.3.1.2.2, the probability of a tornado occurring within the one-degree square in which the Byron Station site is located is 21.0 E-04 per year. The UFSAR indicates, "…annual tornado probability for the Byron site area should be expressed as being in the range of .0010 to .0020, with a tornado return period of about 500 to 1000 years."

The LAR specifies a total of 3,289 tornadoes were reported in the 64 year period (i.e., 1950-2013) and calculates mean unadjusted occurrence rate of 3.11E-04 tornadoes / square mile / year. A correction for annual reporting trend is part of the TORMIS methodology and the adjusted occurrence rate to reflect the sub-region reporting trends is 3.58E−04 tornadoes / square mile / year. The LAR does not provide justification for the information above representing conservative values, nor does the UFSAR markup provided in the LAR indicate that prior information was updated to include new tornado frequency data that will represent new licensing basis information.

Provide a discussion on how these values were derived to represent the most conservative tornado frequency characteristics for both broad and small areas around the plant, including whether the values used are bounding and most conservative or justify accordingly. Also, provide a markup of the UFSAR to indicate changes in tornado frequency represented by the new methodology.

RAI 2 (DSS): UFSAR 2.3.1.2.2 and UFSAR 3.3.1.1 indicate the vertical velocity distribution and gust factors employed for the wind velocities are in accordance with ANSI A58.1-1972. A footnote to UFSAR Table 3.5-4 specifies vertical impact velocities are taken equal to 80% of the horizontal impact velocities. UFSAR 3.5.2 states, "The fans and motors are not protected from vertical or near vertical missiles."

It is unclear whether vertical missiles were addressed in TORMIS analysis.

Provide discussion on how vertical missiles are addressed for unprotected components and update UFSAR to clearly define protection from vertical missiles.

RAI 3 (DSS): LAR Section 3.4.1 indicates, "The results from the finite element analysis were then used to develop critical velocities for the other Byron Station TORMIS missiles. For these selected targets, damage is evaluated by comparing the missile velocity to the damage threshold velocity for the particular missile type and target group. If the missile velocity meets or exceeds the damage threshold velocity, it is scored as damage." UFSAR Table 3.5-4 contains specific values for the licensing basis impact velocities of tornado generated missiles.

Confirm that the missile velocities, used in the finite element analysis and TORMIS, bound the impact velocities in Table 3.5-4 of UFSAR.

RAI 4 (DSS): One of the five review points in the TORMIS SER indicates F-scale tornado classification should be used in order to obtain conservative results. In accordance with UFSAR Section 2.3.1.2.2, the current licensing basis windspeed for the Byron Station are rotational velocity = 290 mph and maximum translational velocity = 70 mph. This is consistent with the 1974 version of RG 1.76 referenced in UFSAR Section 3.3.3.
The LAR submittal states a tornado hazard curve for Byron Station was developed and the EF-scale wind speeds were used in this analysis in accordance with NUREG/CR-4461, Revision 2. The LAR further states the use of EF scale is consistent with the recently endorsed positions of NRC Regulatory Guide 1.76 that are based on NUREG/CR-4461, Revision 2. LAR Table 3.4.5-1 specifies wind speeds for EF5 tornado of 200-230 mph, which could potentially not bound the UFSAR values.

Provide details of windspeeds used in TORMIS and how they meet UFSAR licensing basis wind speeds or justify acceptability. If the intent is to update the licensing basis to incorporate the use of EF Scale and latest revision of RG 1.76, then explain how all differences in the RG revisions are addressed (i.e., missile spectrum, wind speed, faster auto, etc…) and update the UFSAR accordingly.
RAI 5 (DSS): As indicated in LAR Section 3.4.6 (2a), the essential service water (SX) makeup pumps are located in the River Screen House, which is not protected against tornado missiles. For the case of a tornado impacting the river screen house, the non-safety related onsite deep well pumps are used to provide makeup water. The safety related power supply for the deep well pumps is described in UFSAR Section 9.2.5.2.3 and describe specific defense in depth credit for flooding only. The capability for the deep well pumps to provide tornado event SX makeup to the UHS is discussed in UFSAR Section 9.2.5.3.1, and operational assumptions for initiation of the deep water pumps is described with other assumptions for the essential service water cooling tower (SXCT) in Section 9.2.5.3.5 (g). Further, UFSAR Section 3.5.5 appears to describe that conduit in the Auxiliary Building south wall and associated cable vaults that support operation of the deep well pumps are not protected, and are considered as part of the TORMIS analysis (on Table 3.5.17).
Confirm the piping, electrical and infrastructure of the non-safety onsite deep well pumps are adequately tornado protected to provide makeup water to function as defense in depth for SX makeup pumps. If supporting equipment or power for the deep well pumps are not protected from the effects of a tornado, describe how loss of these pumps are considered in TORMIS, and the resultant probabilities for loss of the heat sink function.
Describe why UFSAR Section 9.2.5.2.3 only credits the deep well pumps as alternate makeup for flooding scenarios, but not tornado related scenarios. Additionally, describe how the deep well pumps are credited as alternate makeup in UFSAR Section 9.2.5.3.1 for the effects from tornados if supporting equipment is not protected (as described in Table 3.5.17). Make any appropriate changes to the LAR and UFSAR, as warranted to correct information in the current UFSAR revision.
RAI 6 (DSS): RIS 2008-14 discusses that the application should consider those cases where tornado missile damage to unprotected nonsafety-related SSCs that could adversely impact safety related SSCs. The LAR describes that the unprotected non-safety related Condensate Storage Tanks (CST) and piping from the CSTs to the auxiliary feedwater (AF) pumps located in the Turbine Building are not included in the Byron TORMIS model. The safety related essential service water system is used as the backup suction source for the AF pumps if the CSTs or piping from the CSTs are damaged during a tornado event.

In the event of tornado, confirm failure of CST and secondary effects (e.g., flooding) will not adversely impact safety related SSCs.
RAI 7 (DSS): The LAR markup of UFSAR Page 3.5-23 contains a reduction in wall thickness for tornado barrier. The LAR UFSAR markup shows, “The walls and roofs of structures protecting the safety-related systems and components from design-basis tornado-generated missiles are of reinforced concrete with minimum thickness of “24” (changed to “20”) and 14 inches respectively. The

concrete used has a minimum cylinder strength of 3500 psi at 91 days." This change appears to be outside the scope of the TORMIS submittal.
Describe why this change is appropriate for consideration in this LAR.

RAI 8 (DSS): The LAR states, "The peak heat input to the UHS for a post-tornado two unit shutdown event (which assumes a dual unit loss of offsite power (LOOP)) is much less than the peak heat load imposed on the UHS during a LOCA; therefore, fewer SXCT fans are needed for a post-tornado cooldown of both units; i.e., either 2 or 3 SXCT fans are needed depending on the case."
Section 9.2.5.3.1.1 of the UFSAR indicates, "The accident scenarios analyzed various single active failures and assumed that one or two essential service water cooling tower cells were initially out of service."
Provide additional details on the analysis to verify only 2 SXCT fans are required to safely shutdown both units 1 & 2 during post-tornado conditions and to verify heat loading capability is adequate for post-tornado event shutdown.

RAI 9 (DSS): Table 5 of LAR shows "Deepwell Enclosures" as containing Elect Rm 131Z and 132Z, but does not appear to include Elect Rm 231Z and 232Z. Additionally, Table 5 of LAR contains references to tables defined as "Source Table for Damage Frequency." The staff is unable to locate Table 2-3, 2-4, and 2-6 referenced in the table.
Clarify whether this reference in Table 5 means, for example, "Table 2.6" or "Tables 2 through 6." If applicable, provide the missing Table references, or explain what is contained in the Tables sufficiently for the staff to evaluate the information in Table 5.

RAI 10 (DSS): Section 3.5.4.4 of the UFSAR markup in the LAR appears to make changes to Braidwood specific SSCs. The LAR is specific to changes proposed to Byron.
Justify what appears to be changes to Braidwood in Section 3.5.4.4, or correct the markup to change Byron only UFSAR elements.

RAI 11 (DRA): RIS 2008-14 describes identified items that licensees should address when performing an approved TORMIS methodology per the November 29, 1983, safety evaluation report (SER) (Reference 1 in the Byron LAR). The SER found that the methodology contained in EPRI NP-2005 (Reference 5 in the Byron LAR), is an acceptable approach for demonstrating compliance with the requirements of General Design Criteria (GDC) 2. In Section 2.0 of the LAR, the licensee cites that that the proposed revision to the Byron licensing basis is based on the NRC approved methodology in EPRI NP-2005, as well as other EPRI documents (NP-768 and NP-769).
In NP-2005, Section II, "Probabilistic Models and Simulation Methodology," TORMIS model treatment of a multiple reactor plant is described, specifically how to combine probabilities for a multiple reactor plant in determining the resultant damage probability. Table II-4 and Equations 34 and 35 are used to address multiple reactor targets.
Section 3.4.5 of the LAR describes how the licensee complies with the SER criteria. Item #5 of that section discusses any deviations from the TORMIS calculational approach. There is no discussion or justification referenced for difference in treating multiple unit plants as a different calculational probability, as described in the LAR Attachment 1 Tables 3.4.4-1 and 3.4.4-2, and Attachment 1 Section 4.3, where damage frequency is shown as less than 1.0 E-6 per year, per unit. Additionally, a calculated composite site damage frequency that exceeds 1.0 E-6 is shown on Tables 3.4.4-1 and 3.4.4-2. A precedent is cited with a D.C. Cook safety evaluation (Reference 12 in LAR), where a per reactor/per year result for a two unit plant was described as acceptable; however, the combination of both units probabilities remained below 1.0 E-6 for the TORMIS results, as noted in the staff's safety evaluation.
Justify how your calculation for a per unit/per year aligns with NP-2005, and whether this is a deviation from the model methodology. Additionally, provide information for calculation of the composite site damage frequency, whether that aligns with NP-2005 calculations, and why that result should not be considered for meeting the probability threshold of 1.0 E-6.

RAI 12 (DRA): RIS 2008-14 describes identified items that licensees should address when performing an approved TORMIS methodology per the November 29, 1983, safety evaluation report

(SER) (Reference 1 in the Byron LAR). Section 3.4.5 of the LAR describes how the licensee complies with the SER criteria

In Section 4.4, Conclusions, the licensee states “There are many additional aspects of the TORMIS modeling and inputs that ensure bounding and conservative results.”

Clarify the meaning of this statement and relevance to additional information that is appropriate for staff review. Provide a list of the additional modeling and input parameters on this TORMIS analysis if not already included in the LAR, and evaluate these parameters per criteria listed in Section 3.4.5,

RAI 13 (DRA): RIS 2008-14 describes identified items that licensees should address when performing an approved TORMIS methodology per the November 29, 1983, safety evaluation report (SER) (Reference 1 in the Byron LAR).

In Section 3.4.2, “Boolean Logic Approach,” the licensee states that hit and damage frequencies for groups of targets evaluated in TORMIS are commonly combined using Boolean operators (∪ and ∩) to aid in summarizing the results and understanding the effects of the system redundancies. The union (∪) operator means that if any one of the targets is damaged in a tornado, the system is assumed to fail. The intersection (∩) operator means that all the intersected components must be damaged in a tornado strike for the system to fail. Combinations of union and intersection operators can be put together to describe multi-component system failure logic for plant systems and subsystems.

Clarify if the calculation of any mean (cumulative) tornado missile damage probability uses any intersection (∩) operator that requires damaging multiple targets simultaneously for establishing a damaged state. If multiple targets need to be simultaneously struck, please summarize the guidelines used to identify such groups and explain how they are modeled in TORMIS.

Hearing Identifier: NRR_PMDA
Email Number: 3278

Mail Envelope Properties (Joel.Wiebe@nrc.gov20170119105900)

Subject: Preliminary RAIs for Byron Station TORMIS License Application Request
Sent Date: 1/19/2017 10:59:01 AM
Received Date: 1/19/2017 10:59:00 AM
From: Wiebe, Joel

Created By: Joel.Wiebe@nrc.gov

Recipients:
"Joseph Bauer" <Joseph.Bauer@exeloncorp.com>
Tracking Status: None

Post Office:

Files	**Size**	**Date & Time**
MESSAGE	14555	1/19/2017 10:59:00 AM

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received: