UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
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June 16, 2008

NRC REGULATORY ISSUE SUMMARY 2008-14
USE OF TORMIS COMPUTER CODE FOR ASSESSMENT OF TORNADO MISSILE PROTECTION

ADDRESSES

All holders of operating licenses for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

INTENT

The U.S. Nuclear Regulatory Commission (NRC) is issuing this regulatory issue summary (RIS) to inform addressees of the following:

(1) the NRC staff position on the use of the TORMIS computer code for assessing nuclear power plant tornado missile protection

(2) issues identified in recent license amendment requests to use the TORMIS computer code

(3) information needed in license amendment applications using the TORMIS computer code

This RIS requires no action or written response on the part of an addressee.

BACKGROUND INFORMATION

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[1] (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. Sections 3.5.1.4 and 3.5.2 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (hereafter; referred to as the SRP), contain the current acceptance criteria governing tornado missile protection. These criteria generally specify that structures, systems and components (SSCs) that are important to safety be provided with sufficient, positive tornado missile protection (i.e.,

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[1] The NRC evaluated plants licensed before promulgation of the GDC for tornado missile protection on a plant-specific basis.

barriers) to withstand the maximum credible tornado threat. The appendix to Regulatory Guide1.117, "Tornado Design Classification," Revision 1, issued April 1978, lists the types of SSCs that should be protected from design basis tornadoes. However, SRP 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. To use this probabilistic criterion, the Electric Power Research Institute (EPRI) developed the tornado missile probabilistic methodology described in two topical reports, EPRI NP-768 and NP-769, "Tornado Missile Risk Analysis and Appendices," issued May 1978, and EPRI NP-2005, "Tornado Missile Risk Evaluation Methodology," Volumes I and II, issued August 1981. These topical reports document the TORMIS computer code methodology. The ERPI methodology employs Monte Carlo techniques to assess the probability that tornado missile strikes will cause unacceptable damage to safety-related plant features.

The NRC concluded in a safety evaluation report (SER), dated October 26, 1983 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML080870291, available through the NRC public Web site) that the EPRI TORMIS methodology can be used in lieu of the deterministic methodology when assessing the need for positive tornado missile protection for specific safety-related plant features in accordance with the criteria of SRP Section 3.5.1.4. The SER further stated that the use of the EPRI methodology, or any tornado missile probabilistic study, should be limited to the evaluation of specific plant features that involve additional costly tornado missile protective barriers or alternative systems.

The NRC stated in the SER that applications using the EPRI methodology are to consider the following five points and provide appropriate information:

(1) Licensees should employ data on tornado characteristics for both broad regions and small areas around the site, with the most conservative values used in the risk analysis, or justify the values selected.

(2) Licensees should use the F-scale tornado classification rather than the modified tornado classification, F'-scale, employed in the EPRI studies.

(3) Licensees should calculate the effect of assuming velocity profiles with ratios of speed at ground level (V_0) to speed at the 33-foot elevation (V_{33}) higher than that in the EPRI study. Licensees should discuss the sensitivity of the results to changes in the modeling of the tornado windspeed profile near the ground.

(4) Licensees should provide sufficient information to justify the assumed missile density based on site-specific missile sources and dominant paths of travel.

(5) Licensees should justify any deviations from the calculation approach.

Recent license amendment applications using the TORMIS methodology have resulted in the NRC staff raising a number of questions regarding the application of the TORMIS methodology and implementation of the TORMIS computer code. The NRC staff formally issued some documents as requests for additional information and discussed other questions informally with the licensees. The document, "Selected Requests for Additional Information for License Amendment Applications Using the TORMIS Methodology," (ADAMS Accession No. ML073470329) contains a list of specific questions raised by the NRC staff.

The questions fall into three general areas:

(1) Licensees did not fully satisfy the first four points identified in the SER approving the TORMIS methodology (identified above). Examples include the following:

a. not providing adequate justification that the analysis used the most conservative value for tornado frequency

b. not including the entire missile spectrum defined for use in the TORMIS computer code as appropriate for the plant

c. not providing adequate explanation for the number and adequacy of tornado simulations and histories

d. not providing sufficient information regarding the development and use of area ratios

(2) Licensees did not fully address the fifth point identified in the SER and explain how the methodology was implemented when the parameters used differed from those specified in the TORMIS methodology. Examples include the following:

a. inappropriately limiting the number of targets modeled

b. failing to address missile tumbling when modeling targets

c. failing to properly consider and use the variance reduction techniques and parameters specified by TORMIS

d. taking credit for nonstructural members

e. failing to consider risk-significant, non-safety-related equipment

(3) Licensees used the TORMIS methodology to address situations for which the methodology was not approved. Examples include the following:

a. proposing the elimination of existing tornado barriers

b. proposing technical specification (TS) changes

c. proposing plant modifications

SUMMARY OF ISSUE

USE OF TORMIS

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.

The TORMIS methodology is approved for situations where (1) a licensee identifies existing plant 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.

In "Position On the Use of Probabilistic Risk Assessment In Tornado Missile Protection Licensing Actions," (ADAMS Accession No. ML080870287) the NRC staff states the following:

> …the guidance of SRP Section 2.2.3 is applicable to tornado missiles. This guidance, which we will use in our probabilistic tornado missile reviews, states that an expected rate of occurrence of potential exposures in excess of the 10 CFR 100 guidelines of approximately 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the risk can be expected to be lower.

When developing qualitative arguments to support the quantitative analysis obtained using TORMIS, licensee applications can consider surviving nonsafety-related SSCs including those afforded positive tornado missile protection where these nonsafety-related SSCs can substitute for safety-related SSCs that are postulated to be damaged by the tornado. However, the application should consider those cases where tornado missile damage to unprotected nonsafety-related SSCs could adversely impact safety-related SSCs. The following provide examples:

- A tornado missile protected nonsafety-related fire water pump may substitute for the normally relied on safety-related makeup source.

- A normally operating nonsafety-related non-tornado missile protected cooling water system may fail in a manner that compromises the ability of the safety-related backup cooling water system to perform the required function.

- A tornado missile and its associated damage could block access to essential areas when required manual actions need to be performed.

The TORMIS methodology is not currently approved for the following:

- justifying not providing positive tornado missile protection (i.e., barriers) for plant modifications

- removing existing tornado missile barriers

- eliminating or relaxing of TS requirements that have been established for tornado missile barriers and safety-related equipment

- promoting operational flexibility or convenience

The initial use of the TORMIS methodology as described in this RIS requires a license amendment in accordance with 10 CFR 50.59(c)(2)(viii) and subsequent revision to the plant licensing basis because it is a "Departure from the method of evaluation described in the Final Safety Analysis Report (FSAR) (as updated) used in establishing the design bases or in the safety analysis" as defined in 10 CFR 50.59(a)(2). Once the TORMIS methodology has been approved for the plant and incorporated in the plant licensing basis, it can be used to address

additional tornado missile vulnerabilities identified in the future without seeking NRC approval, provided its use is consistent with the approved licensing basis of the plant.
Updated FSARs typically identify how SSCs are protected from tornado missiles. Since the TORMIS methodology establishes a basis for not providing positive tornado protection, licensees will need to update the plant licensing basis for tornado missile protection to identify the SSCs for which the TORMIS methodology applies. This update should include limiting assumptions that were used, any exceptions to the TORMIS methodology that were approved, and other factors that are credited for satisfying the acceptance criteria. Note that the TORMIS acceptance criteria are based on the cumulative effects of tornado missile damage to all safety-related SSCs that are not provided positive protection. Therefore, when using TORMIS to address any additional tornado missile vulnerabilities that are identified in the future, the analysis should include those SSCs that were previously analyzed. Additionally, future uses of TORMIS should reconsider the qualitative factors that are pertinent.

APPLICATIONS USING THE TORMIS METHODOLOGY

License amendment applications for use of the TORMIS methodology should "…consider the following [five] points and provide appropriate information" (see "BACKGROUND INFORMATION" above), as stated in the SER approving TORMIS. In addition, the NRC staff has identified issues with the implementation of the TORMIS computer code and methodology in recent applications (see ADAMS Accession No. ML073470329). License amendment applications should provide adequate and sufficient information for the NRC staff to confirm that applicants properly applied and implemented the TORMIS methodology and computer code. For example, they should discuss the qualitative considerations that are used to demonstrate that the actual probability is expected to be lower than the calculated value. As another example, the TORMIS manual specifies that the dimensions of targets should be increased to account for the uncertainty resulting from the tumbling of missiles (i.e., impact offset effect) and suggests increasing the free surface area by the average missile length divided by 8 (L/8). Applications should discuss how the licensee considered the tumbling of missiles when modeling the targets.

One exception to the use of the TORMIS methodology and computer code as originally approved by the NRC is the use of updated tornado characteristics as identified in Table 1 of Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1, issued March 2007. The number and types of tornadoes and tornado missiles remain as identified in the TORMIS code.

OTHER WAYS OF ADDRESSING TORNADO MISSILE PROTECTION

It should be noted that current NRC approval for implementation of TORMIS is not a risk informed approach, even though the method utilizes acceptance criteria for the probability of tornado induced loss of system function. As such, approval of TORMIS allows an alternate method for meeting regulatory requirements under very specific circumstances with respect to the evaluation of specific plant features where additional costly tornado missile protective barriers or alternate systems are under consideration.

A licensee may submit a license amendment application proposing other means for modifying the current licensing basis for tornado missile protection. Such an application could utilize a risk-informed change process consistent with the guidelines of Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decision on Plant-Specific Changes to the Licensing Basis." Likewise, a licensee can submit a license amendment to revise plant TSs associated with tornado missile features in accordance with Regulatory Guide 1.177, "An Approach for Plant-Specific Risk-Informed Decision Making: Technical

Specifications," issued August 1998. If a risk-informed process was proposed, it would have to meet the five key principles of risk informed regulation called out in Regulatory Guide 1.174, including the need for possible exemptions to the regulations or GDC requirements. Sufficient probabilistic risk assessment quality with respect to modeling of tornado initiators would have to be demonstrated. A topical report consistent with the above guidelines could be submitted for NRC staff review.

BACKFIT DISCUSSION

This RIS discusses the use of the TORMIS methodology and issues identified by the NRC staff during the review of applications using the TORMIS methodology for tornado missile protection. The NRC approved the TORMIS methodology in 1983 for use in limited situations as an alternative method to the deterministic approach - the licensing basis for all nuclear power plants - for demonstrating compliance with the tornado missile protection requirements of GDC 2 and 4. This RIS does not alter the NRC staff position established in 1983 for the use of the TORMIS methodology. Since the TORMIS methodology is an "alternative" method to the licensing basis deterministic approach for complying with NRC requirements, and not a requirement, there is no action required of licensees. Therefore, any action on part of addresses in accordance with the guidance contained in this RIS is strictly voluntary and, therefore; is not a backfit under 10 CFR 50.109, "Backfitting." Consequently, the NRC staff did not perform a backfit analysis.

FEDERAL REGISTER NOTIFICATION

A public meeting to discuss the RIS and receive comments from interested parties was held on February 29, 2008. Meeting minutes appear under ADAMS Accession No. ML081070503. Resolutions to the comments appear under ADAMS Accession No. ML081050468.

CONGRESSIONAL REVIEW ACT

This RIS is not subject to the Congressional Review Act.

PAPERWORK REDUCTION ACT STATEMENT

This Regulatory Issue Summary does not contain any information collections and, therefore; is not subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.).

Public Notice Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid Office of Management and Budget control number

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Please direct any questions about this matter to the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation project manager.

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Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under the heading Document Collections within the Electronic Reading Room.

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