



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 8, 2018

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer (CNO)
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 - ISSUANCE OF AMENDMENTS
REGARDING USE OF TORMIS FOR ASSESSING TORNADO MISSILE
PROTECTION (EPID L-2018-LLA-0036)

Dear Mr. Hanson:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 199 to Renewed Facility Operating License No. NPF-72 and Amendment No. 199 to Renewed Facility Operating License No. NPF-77 for the Braidwood Station, Units 1 and 2, respectively. The amendments are in response to your application dated February 1, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18036A227), as supplemented by letters dated July 9, 2018 (ADAMS Accession No. ML18191B304), and August 3, 2018 (ADAMS Accession No. ML18215A421).

The amendments revise the Braidwood Station, Units 1 and 2, licensing basis for protection from tornado generated missiles.

A copy of the Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

A handwritten signature in black ink that reads "Joel S. Wiebe".

Joel S. Wiebe, Senior Project Manager
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-456 and STN 50-457

Enclosures:

1. Amendment No. 199 to NPF-72
2. Amendment No. 199 to NPF-77
3. Safety Evaluation

cc: Listserv



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

EXELON GENERATION COMPANY, LLC

DOCKET NO. STN 50-456

BRAIDWOOD STATION, UNIT 1


AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 199
Renewed License No. NPF-72

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Exelon Generation Company, LLC (the licensee) dated February 1, 2018, as supplemented by letters dated July 9, 2018, and August 3, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
 - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 199, the Renewed Facility License No. NPF-72 is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated February 1, 2018, as supplemented by letters dated July 9, 2018, and August 3, 2018. The licensee shall update the UFSAR to incorporate the TORMIS Computer Code as the methodology used for assessing tornado generated missile protection of unprotected plant structures, systems, and components (SSCs) and to describe the results of the Braidwood Station site specific tornado hazard analysis as described in the licensee's application dated February 1, 2018, as supplemented by letters dated July 9, 2018, and August 3, 2018, and the NRC staff's safety evaluation attached to this amendment, and shall submit the revised description authorized by this amendment with the next periodic update of the UFSAR as required by 10 CFR 50.71(e).
3. This license amendment is effective as of the date of its issuance and shall be implemented within 90 days of the date of issuance. The UFSAR changes shall be filed with the NRC in the next periodic update to the UFSAR as required by 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



David J. Wrona, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: November 8, 2018



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

EXELON GENERATION COMPANY, LLC

DOCKET NO. STN 50-457

BRAIDWOOD STATION, UNIT 2

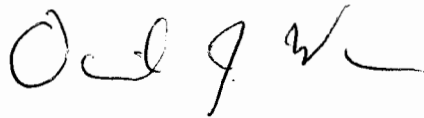
AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 199
Renewed License No. NPF-77

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Exelon Generation Company, LLC (the licensee) dated February 1, 2018, as supplemented by letters dated July 9, 2018, and August 3, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
 - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. 199, the Renewed Facility License No. NPF-77 is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated February 1, 2018, as supplemented by letters dated July 9, 2018, and August 3, 2018. The licensee shall update the UFSAR to incorporate the TORMIS Computer Code as the methodology used for assessing tornado generated missile protection of unprotected plant structures, systems, and components (SSCs) and to describe the results of the Braidwood Station site specific tornado hazard analysis as described in the licensee's application dated February 1, 2018, as supplemented by letters dated July 9, 2018, and August 3, 2018, and the NRC staff's safety evaluation attached to this amendment, and shall submit the revised description authorized by this amendment with the next periodic update of the UFSAR as required by 10 CFR 50.71(e).
3. This license amendment is effective as of the date of its issuance and shall be implemented within 90 days of the date of issuance. The UFSAR changes shall be filed with the NRC in the next periodic update to the UFSAR as required by 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



David J. Wrona, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: November 8, 2018



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED
TO AMENDMENT NO. 199 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-72
AND AMENDMENT NO. 199 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-77
EXELON GENERATION COMPANY, LLC
BRAIDWOOD STATION, UNITS 1 AND 2
DOCKET NOS. STN 50-456 AND STN 50-457

1.0 INTRODUCTION

By letter dated February 1, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18036A227, Reference 1), as supplemented by letters dated July 9, 2018 (ADAMS Accession No. ML18191B304, Reference 2), and August 3, 2018 (ADAMS Accession No. ML18215A421, Reference 3), Exelon Generation Company, LLC (EGC, the licensee), submitted a request to the U.S. Nuclear Regulatory Commission (NRC or the Commission) to revise licensing bases by revising the Updated Final Safety Analysis Report (UFSAR) for protection from tornado-generated missiles for Braidwood Station, Units 1 and 2. The proposed license amendment describes the methodology and result of analysis performed to evaluate the protection of plant's structures, systems, and components (SSCs) from tornado-generated missiles. This analysis utilized a Monte Carlo simulation methodology to assess, through the TORMIS methodology, the probability of multiple missile hits causing unacceptable damage to unprotected safety-significant SSCs at the Braidwood plant.

The typical method used is to provide positive protection features such as locating required equipment in structures designed for tornado missiles or providing barriers designed for tornado missiles. The licensee is requesting a change to the Braidwood Station, Units 1 and 2, licensing bases to allow certain components to not be protected from tornado missiles based on use of a simulation computer code TORMIS.

The Electric Power Research Institute (EPRI) developed the TORMIS methodology. TORMIS computer code employs Monte Carlo techniques in order to simulate the transport of tornado-generated missiles and to assess the frequency of missile strikes causing damage to unprotected SSCs. TORMIS estimates the cumulative annual frequency of missiles striking and damaging individual target SSCs and groups of target SSCs.

2.0 REGULATORY EVALUATION

The NRC requires that nuclear power plants be designed to withstand the effects of natural phenomena, including 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 Title 10 of the *Code of*

Federal Regulations (10 CFR), Part 50, Appendix A, General Design Criterion (GDC) 2, "Design Bases for Protection against Natural Phenomena," and GDC 4, "Environmental and Dynamic Effects Design Bases." Methods acceptable to the NRC to comply with these regulations are described in Regulatory Guide (RG) 1.117, "Tornado Design Classification," Revision 1, April 1978 (Reference 10) and NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP), Section 3.5.1.4, "Missiles Generated by Natural Phenomena," and Section 3.5.2, "Structures, Systems, and Components to be Protected from Externally-Generated Missiles," Revision 2, July 1981 (Reference 11).

Sections 3.5.1.4 and 3.5.2 of the SRP provides acceptance criteria governing tornado missile protection that apply to the Braidwood station. These criteria generally specify that SSCs important to safety be provided with sufficient, positive tornado missile protection (i.e., barriers) to withstand the maximum credible tornado threat. The appendix to RG 1.117, Revision 1, issued April 1978, lists the types of SSCs needing protection from design basis tornadoes. SRP Section 3.5.1.4 permits relaxation of the above deterministic criteria if it can be demonstrated that the frequency of damage to unprotected essential safety-related features is sufficiently small. To use this probabilistic approach, the EPRI developed the tornado missile probabilistic methodology described in topical reports, EPRI NP-768 and NP-769 (References 4 and 5) and EPRI NP-2005 (Reference 6). These topical reports document the TORMIS computer code methodology. The EPRI methodology employs Monte Carlo techniques to assess the frequency of tornado missile strikes that will cause unacceptable damage to safety-related plant features.

The NRC staff issued a safety evaluation report (SER), dated October 26, 1983 (Reference 7) that concluded 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. In that SER, the staff concluded that the methodology had limitations for its use and that licensees must consider five plant-specific points and provide appropriate information regarding its use. The five points and the licensee's responses are summarized in Section 3.2 below:

In June 16, 2008, the NRC issued Regulatory Issue Summary (RIS) 2008-14, "Use of TORMIS Computer Code for Assessment of Tornado Missile Protection," (Reference 8). This RIS addresses: (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 previous license amendment requests to use the TORMIS computer code, and (3) information needed in license amendment applications using the TORMIS computer code. As specified in RIS 2008-14, 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. The TORMIS methodology is not approved for justification of existing missile barrier removal, either temporarily or permanently.

Although the TORMIS methodology utilizes acceptance criteria for the frequency of tornado induced loss of system function, the NRC approval for implementation of TORMIS is not a risk-informed approach. 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.

3.0 TECHNICAL EVALUATION

3.1 Background

The current licensing basis for tornado missile protection is presented in Braidwood UFSAR Sections 3.5.3, "Barrier Design Procedures," and 3.5.4, "Analysis of Missiles Generated by a Tornado" (ADAMS Accession No. ML17086A600). Most safety-related systems and components are located inside structures designed to protect them from tornado-generated missiles as discussed in UFSAR, Section 3.5.3.

Section 3.5.4 of the UFSAR describes the licensing basis for safety-related components located outdoors. Section 3.5.4 states the following:

Effects of tornado missiles have been assessed for safety-related components located outdoors. These components are the SXCTs [essential service water cooling towers] (Byron only), the emergency diesel exhaust stacks, emergency diesel generator (EDG) ventilating and combustion air intake, EDG crankcase vents, and the main steam safety and power operated relief valve tailpipes (Braidwood only).

Section 3.5.4 provides a discussion addressing how the existing missile protection (or lack of missile protection) is acceptable.

The basis for tornado missile protection in UFSAR Section 3.1.2.1.2, states, in part, that, "Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions." It further specifies that the design for these stations conforms to the intent of GDC Criterion 2 and commits to meeting GDC Criterion 4. The plural "stations" refers to Byron and Braidwood Stations, as portions of the UFSAR are applicable to both stations.

NRC Inspection Report 05000454/2009004; 05000455/2009004, dated November 5, 2009 (reference 12), identified a non-cited violation at the Byron Station for failure to protect the various components listed. These same missile vulnerabilities were also applicable to Braidwood Station. On May 25, 2016, Braidwood Station issued Event Notification Report No. 51959¹, "Discovery of Non-conforming Conditions during Tornado Hazards Analysis," which documents non-conforming conditions in the plant design such that specific technical specifications equipment on both units is considered to be inadequately protected from tornado missiles. To resolve the above concerns and close out the Operability Evaluation, Braidwood Station has decided to pursue NRC approval to utilize the TORMIS Computer Code methodology for assessing tornado-generated missile protection.

Use of TORMIS is subject to the appropriate resolution of five specific concerns identified in the SER for the EPRI TORMIS methodology (Reference 7). These specific concerns are related to the assumptions used in the input parameters for the analysis (e.g., locations and numbers of potential missiles presented at a specific site, wind speed, wind speed near the ground, etc.). The NRC staff reviewed the submittal with respect to: (1) the licensee's resolution of the five specific concerns, and (2) the acceptability of the licensee's TORMIS analysis for calculating the

¹ Available from the NRC public website at <https://www.nrc.gov/reading-rm/doc-collections/event-status/event/2016/20160526en.html>.

appropriate mean strike and damage probabilities and of the TORMIS results against the guidance provided in the SER on EPRI TORMIS methodology and RIS 2008-14.

The Braidwood Station TORMIS results provide estimated probabilities of tornado missile hits and damage to modeled targets. There were six unprotected safety-significant components (modeled as 74 individual targets) included in the TORMIS analysis, as shown in the licensee's letter dated February 1, 2018, Attachment 1-1, Table 3, "Mean Damage Frequency (per Year) for Braidwood Station Target Groups." For the Braidwood Station TORMIS analysis, the plant was divided into two separate models because of the remote location of the essential service water (SX) discharge pipes in the middle of the ultimate heat sink cooling pond, nearly a mile from the closest other safety-significant targets. The main site model is used to analyze all targets on and around the reactor and auxiliary buildings. The SX model is used to analyze the SX discharge pipe targets only. The SX discharge pipes are located in the middle of the SX cooling pond.

The licensee considered systems or portions of systems such as, SX discharge pipes, control room air intake, diesel auxiliary feed pump exhaust, power-operated relief valve and main steam safety valve tailpipe, miscellaneous electric equipment room ventilation openings, and refueling water storage tank (RWST) hatch.

In its letter dated February 1, 2018, the licensee committed to protecting the RWST hatches in Attachment 1A of their submittal. In its letter dated August 3, 2018, the licensee confirmed that the associated engineering changes to protect the RWST hatches were completed.

In "Position on the Use of Probabilistic Risk Assessment in Tornado Missile Protection Licensing Actions," (ADAMS Accession No. ML080870287) the NRC staff states that the guidance of SRP, Section 2.2.3, "Evaluation of Potential Accidents" (ADAMS Accession No. ML070460336), is applicable to tornado missiles. This guidance which is used in probabilistic tornado missile reviews, states that an expected rate of occurrence of potential exposures in excess of the 10 CFR Part 100 guidelines of approximately 1×10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the risk can be expected to be lower.

As noted in its February 1, 2018, letter, the licensee documents in its Braidwood Station TORMIS results that if no additional missile protection is provided, the damage frequency exceeds the acceptance value of $1.0E-06$ per year for both Units 1 and 2. As demonstrated in its TORMIS analysis, the licensee meets the acceptance criteria ($1.0E-06$ per year) by protecting the RWST hatches.

3.2 Implementation of the TORMIS Methodology

As noted above, the SER (Reference 7), approving the TORMIS methodology requires licensees using the methodology to consider and address five points in their applications. The five points and the licensee's responses are summarized below:

- (1) Data on tornado characteristics should be employed for both broad regions and small areas around the site. The most conservative values should be used in the analysis or justification provided for those values selected.

In its February 1, 2018, letter, the licensee performed a site-specific analysis to generate a tornado hazard curve for the Braidwood Station and a data set for the TORMIS analysis. The National Oceanic Atmospheric Administration Storm Prediction Center

Severe Weather Database was used to identify a homogenous sub-region around the station. The sub-region tornado occurrence rate, Enhanced Fujita (EF) scale intensities, path length, width, and direction variables have been analyzed for use in the TORMIS analysis. A tornado hazard curve for Braidwood Station was developed and the EF-scale wind speeds were used in this analysis in accordance with NUREG/CR-4461, Revision 2 (Reference 13).

A total of 9282 tornadoes were reported in the 64-year period (i.e., 1950-2013), producing an average of 145.03 per year. The Licensee calculated the adjusted tornado occurrence rate at 1.04E-03 tornadoes/square mile/year. This value is relatively consistent with the current values given in the UFSAR of 9.17E-04 tornados/square mile/year for 1955–1967 data.

Based on licensee use of most recent data, derived with more emphasis on reporting and verification of tornadoes resulting in higher quality data, the NRC staff concludes this is acceptable.

- (2) The EPRI study proposes a modified tornado classification, F'-scale, for which the velocity ranges are lower by as much as 25-percent of the velocity ranges originally proposed in the Fujita, F-scale. Insufficient documentation was provided in the studies in support of the reduced F'-scale. The Fujita F-scale tornado classifications should therefore be used in order to obtain conservative results.

The licensee stated that the original EF scale wind speeds were utilized in the analysis. The hazard curve developed for the Braidwood Station analysis does not utilize either the SER specified Fujita (F) scale or the SER prohibited modified Fujita (F') scale. Instead the analysis utilizes the EF scale wind speeds as per NUREG/CR-4461. Although the 1983 NRC SER called for the use of the F-scale of tornado intensity for assigning tornado wind speeds to each intensity category (F1-F5), the NRC subsequently adopted the EF scale in the positions of Regulatory Guide 1.76, Revision 1 (Reference 14) that are based on NUREG/CR-4461, Revision 2.

Braidwood Station's design basis windspeed (290 miles per hour (mph) rotational velocity) is consistent with the 1974 version of RG 1.76 and exceeds the EF5 windspeed of 230 mph shown in Table 3.3.5-1 of the licensee's February 1, 2018, letter; however, the use of the EF scale wind speeds is limited to evaluation of unprotected equipment using TORMIS. The licensee has no intent to update the entire licensing basis to utilize RG 1.76, Revision 1, and added a statement to UFSAR, Section 3.5.5.a, to identify the limitation on EF-Scale use to TORMIS simulations only. Based on limitations of use and the data consistency with current NRC regulations, the staff concludes use of the EF scale is acceptable for analyzing SSC's within this TORMIS application.

- (3) Reductions in tornado wind speed near the ground due to surface friction effects are not sufficiently documented in the EPRI study. Such reductions were not consistently accounted for when estimating tornado wind speeds at 33 feet above grade on the basis of observed damage at lower elevations. Therefore, the user should calculate the effects of assuming velocity profiles with ratios V_0 (speed at ground level)/ V_{33} (speed at 33 foot elevation) higher than that in the EPRI study. Discussion of the sensitivity of the results to changes in the modeling of the tornado wind speed profile near the ground should be provided.

The licensee's letter dated February 1, 2018, identifies that its TORMIS simulations were performed with the TORMIS rotational velocity Profile 3, which has increased near ground wind speeds over Profile 5, which was used in the 1981 EPRI TORMIS reports. The use of Profile 3 with higher near-ground wind speeds is conservative when compared to Profile 5. A sensitivity study was conducted by running the original EPRI profiles which resulted in negligible differences at very low damage frequencies for missile hit. Therefore, the Braidwood Station runs were made with higher near ground wind speeds than in the EPRI study. The NRC staff concludes this is reasonable and acceptable.

- (4) The assumptions concerning the locations and numbers of potential missiles presented at a specific site are not well established in the EPRI studies. However, the EPRI methodology allows site-specific information on missile availability to be incorporated in the risk calculation. Therefore, users should provide sufficient information to justify the assumed missile density based on site-specific missile sources and dominant tornado paths of travel.

The licensee performed walkdowns of the Braidwood Station Units 1 and 2 site during unit outages, which increased the numbers of potential missiles at the site. The survey walkdown uses a systematic, documented process to provide input on what missiles are in each missile zone, the minimum and maximum injection heights for all missiles by missile type, the building characteristics for structures in the missile zone, and pictures of the missiles and buildings surveyed. The mean number of potential missiles simulated for EF5 tornadoes was 383,420, including structural failure missile sources. Missile sources were catalogued and modeled to a distance of approximately 2,500 feet. This process developed missile origin zones around the plant for the Braidwood Station main site model and the SX model separately. The process surveyed the types and quantities of missiles in each zone. The simulated missile count from the main site model and the SX model are substantially different due to the distance between modeled targets. The process provides the maximum number of missiles produced given the destruction of the buildings. These are calculated with specific wind fragilities (known or estimated) with HAZUS software, based on wind characteristics and building type. Similar plant designs, noted as precedence in the licensee's February 1, 2018, letter, contain similar buildings, but Braidwood Station building deconstruction missiles for higher wind tornadoes seems very conservative. Missile count and details of development of origin zones depicting the representative type, quantity, or density of zonal missiles was not provided. As a result, it was unclear to the NRC staff how such a variation in missile count was derived. The staff requested the licensee to provide details of the assumed missile density based on location-specific missile counts used in analysis. To further explain values, the licensee in its letter dated July 9, 2018, responded with details and tables describing the process for defining missile zones and quantities for deriving final missile count. The tables show 39 separate origin zones for the main site model and 7 zones for the SX model. These boundaries were used as the basis for the field missile surveys. The licensee also explained derivation of structural missiles estimates. Based on the above, the NRC staff finds the postulated missile quantities are reasonable.

- (5) Once the EPRI methodology has been chosen, justification should be provided for any deviations from the calculational approach.

In its letter dated February 1, 2018, the licensee stated that the TORMIS code, a legacy computer code, has been updated to modern computers. Although not evaluated, the updates and enhancements include: porting the legacy code from the mainframe to minicomputer to PC computers; post processing data routines; updating the random number generation; updating the aerodynamic tip loss function; and addressing compiler differences and numerical round-off issues in various functions from the legacy code. An enhanced method was used for evaluating missiles passing through openings such as pipe penetrations in concrete walls. This method uses a screening of missile impact conditions to evaluate missile impacts that can obviously not pass through an opening. This approach provides an additional output option for estimating the probabilities of missiles passing through small openings in concrete barriers. Based on the types of updates identified, the NRC staff finds these deviations reasonable and acceptable.

Based on the above, the NRC staff determined that the licensee considered and appropriately addressed each of the five points described in the NRC TORMIS SER, dated October 26, 1983. The staff finds the licensee's analysis meets the guidance of SRP, Section 3.5.1.4, which permits relaxation of the deterministic guidance in SRP, Sections 3.5.1.4 and 3.5.2, as allowed by the NRC TORMIS SER dated October 26, 1983.

In addition to the five points above, the NRC issued RIS 2008-14, "Use of TORMIS Computer Code for Assessment of Tornado Missile Protection" to inform licensees of additional details needed to provide adequate and sufficient information for the NRC staff to confirm that applicants properly applied and implemented the TORMIS methodology. To address the guidance of the RIS, the licensee in its letter dated February 1, 2018, considered these RIS observations in the development of the TORMIS analysis and addressed each item of RIS 2008-14 individually.

One concern mentioned in RIS 2008-14 is inappropriately limiting the number of targets modeled. To address this concern, the licensee in its letter dated February 1, 2018, provides a discussion of procedural or compensatory measures for not including components in the TORMIS analysis. The licensee provided additional justification in its letter dated July 9, 2018, related to procedural and compensatory actions performed in event of vent line obstruction of Unit 2 auxiliary feed (AF) pump diesel engine day tank. The single required action is performed in the 2B AF pump room located in an accessible portion of the auxiliary building.

In its review described above, the NRC staff considered the issues identified in the RIS and by its acceptance of the licensee's TORMIS analysis, determined that the licensee adequately addressed the concerns noted in the RIS. The NRC staff finds the licensee has provided adequate information to address concerns noted in this RIS.

3.3 Results of the Braidwood Unit 1 & 2 TORMIS Analysis

The licensee proposed changes to Section 3.5.5 of the UFSAR, in addition to many applicable Byron Station-approved TORMIS changes. The licensee's letter dated February 1, 2018, states that a TORMIS analysis was completed to address plant components located in areas not fully protected by missile barriers designed to resist impact from design-basis tornado missiles. These unprotected targets are identified in its letter and incorporated into UFSAR Table 3.5-18. The licensee states that Braidwood Station TORMIS results show the arithmetic sum of damage frequencies for all target groups affecting the individual units (i.e., Unit 1 plus common components and Unit 2 plus common components) are lower than the acceptable threshold frequency of 1.0E-06 per year, established in SRP, Section 2.2.3. These values include the

damage frequency from the SX model for the SX discharge pipes which are the only common unit targets at Braidwood Station.

Table 3.3.3-1 in Section 3.3.3 of the licensee's letter dated February 1, 2018, provided the estimated damage frequencies of 1.19E-06 and 5.26E-07 for Unit 1 for all target groups and following protection of RWST hatches, respectively, and estimated damage frequencies of 1.29E-06 and 5.8E-07 for Unit 2 for all target groups and following protection of RWST hatches, respectively. The licensee further stated that each individual unit and composite site damage frequency meets the acceptance criteria of 1.0E-06 per year established in SRP Section 2.2.3, "Evaluation of Potential Accidents," and the NRC memorandum from Harold R. Denton to Victor Stello, "Position on Use of Probabilistic Risk Assessment in Tornado Missile Protection Licensing Actions," dated November 7, 1983 (Reference 9), following protection of the RWST hatches. The estimated composite site damage frequency is 9.96E-07 per year following protection of RWST hatches. In its letter dated August 3, 2018, the licensee confirmed that the associated engineering changes needed to protect the RWST hatches have been completed.

Based on the above, the NRC staff finds that because missile protection is not provided for the identified targets which have been analyzed by the TORMIS code, the probability of a malfunction of equipment important to safety will slightly increase. However, the frequency of a tornado-generated missile damaging these targets is less than 1×10^{-6} per year and meets the guidance described in the SRP Section, 2.2.3.

3.4 Conclusion

Based on the above evaluation, the NRC staff finds that the licensee has adequately addressed the items identified in the NRC SER approving the TORMIS methodology and also concludes that the EPRI TORMIS methodology is implemented appropriately in accordance with the guidance provided in the 1983 TORMIS SER and RIS 2008-14. Furthermore, the staff finds that the reported results comply with the NRC guidance and are acceptable. Therefore, the NRC staff finds that the licensee's proposed revisions to Sections 3.3-1 through 3.5-50 of the UFSAR appropriately reflect Braidwood Station, Units 1 and 2, compliance with the NRC guidance and the use of NRC-approved methodology for TORMIS analysis.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Illinois State official was notified on October 10, 2018, of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change requirements with respect to installation or use of a facility's components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (83 FR 23734; May 22, 2018). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no

environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U. S. NRC, "License Amendment Request to Utilize the TORMIS Computer Code Methodology," dated February 1, 2018 (ADAMS Accession No. ML18036A227)
2. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U. S. NRC, " Response to Request for Additional Information Regarding Braidwood TORMIS Amendment Request," dated July 9, 2018 (ADAMS Accession No. ML18191B304)
3. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U. S. NRC, "Supplement to License Amendment Request to Utilize the TORMIS Computer Code Methodology," dated August 3, 2018 (ADAMS Accession No. ML18215A421)
4. Electric Power Research Institute Report – EPRI NP-768, "Tornado Missile Risk Analysis," May 1978 (Available from Electric Power Research Institute, 3420 Hillview Avenue, Palo Alto, California 94304)
5. Electric Power Research Institute Report – EPRI NP-769, "Tornado Missile Risk Analysis - Appendices," May 1978 (Available from Electric Power Research Institute, 3420 Hillview Avenue, Palo Alto, California 94304)
6. Electric Power Research Institute Report – EPRI NP-2005 Volumes, I and 2, "Tornado Missile Risk Evaluation Methodology," August 1981 (Available from Electric Power Research Institute, 3420 Hillview Avenue, Palo Alto, California 94304)
7. NRC Safety Evaluation Report, " Electric Power Research Institute (EPRI) Topical Reports Concerning Tornado Missile Probabilistic Risk Assessment (PRA) Methodology," dated October 26, 1983 (ADAMS Accession No. ML080870291)
8. NRC Regulatory Issue Summary 2008-14, "Use of TORMIS Computer Code for Assessment of Tornado Missile Protection," dated June 16, 2008 (ADAMS Accession No. ML080230578)
9. NRC Memorandum from Harold R. Denton to Victor Stello, "Position of Use of Probabilistic Risk Assessment in Tornado Licensing Actions," dated November 7, 1983 (ADAMS Accession No. ML080870287)

10. Regulatory Guide 1.117, Revision 1, "Tornado Design Classification," issued April 1978 (ADAMS Accession No. ML003739346)
11. NUREG-0800, Revision 0, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," 3.5.1.4 (ADAMS Accession No. ML052340526) and 3.5.2 (ADAMS Accession No. ML052340540)
12. NRC Inspection Report, 05000454/2009004; 05000455/2009004, dated November 5, 2009 (ADAMS Accession No. ML093100141)
13. NUREG/CR-4461, Revision 2, "Tornado Climatology of the Contiguous United States, (PNNL-15112, Rev 2)," Ramsdell and Rishel, 2007 (ADAMS Accession No. ML070810400)
14. Regulatory Guide 1.76, Revision 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," issued March 2007 (ADAMS Accession No. ML070360253)

Principal Contributors: Gordan Curran, NRR
Courtney St. Peters, R-III
Mehdi Reisi-Fard, NRR
Greg A. Casto, NRR

Date: November 8, 2018

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 - ISSUANCE OF AMENDMENTS REGARDING USE OF TORMIS FOR ASSESSING TORNADO MISSILE PROTECTION (EPID L-2018-LLA-0036) DATED NOVEMBER 8, 2018

DISTRIBUTION:

PUBLIC
 PM File Copy
 RidsNrrDorlLpl3-2 Resource
 RidsNrrLASRohrer Resource
 GCurran, NRR
 MReisifard, NRR

RidsNrrDssStsb Resource
 RidsRgn3MailCenter Resource
 RidsNrrPMBraidwood Resource
 RidsACRS_MailCTR Resource
 CSt. Peters, R-III

ADAMS Accession No.: ML18291A980

*via memo

**via e-mail

OFFICE	DORL/LPL3/PM	DORL/LPL3/LA	DSS/SCP/BC	DRA/APLB/BC	OGC - NLO
NAME	JWiebe	SRohrer	SAnderson*	GCasto*	DRoth**
DATE	10/22/18	10/22/18	9/26/18	9/7/18	10/31/18
OFFICE	DORL/LPL3/BC	DORL/LPL3/PM			
NAME	DWrona	JWiebe			
DATE	11/8/18	11/8/18			

OFFICIAL RECORD COPY