Omaha Public Power District
444 South 16th Street Mall
Omaha, NE 68102-2247

July 21, 2013
LIC-13-0061

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

References:
1. Docket No. 50-285
2. Regulatory Guide 1.76, Revision 1, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” dated March 2007
3. Bechtel Power Corporation, Topical Report BC-TOP-9A, “Design of Structures for Missile Impact,” Revision 2, September 1974
4. NAV DOCKS P-51, “Design of Protective Structures,” (A New Concept of Structural Behavior), Arsham Amirikian, Presented at the Annual Meeting of the American Society of Civil Engineers in Chicago IL, October 11-14, 1950) Bureau of Yards and Docks, Department of the Navy, August 1950 (Unclassified)

SUBJECT: Exigent License Amendment Request 13-02 Revise Current Licensing Basis to Adopt a Revised Design Basis / Methodology for Addressing Design-Basis Tornado / Tornado Missile Impact

Pursuant to 10 CFR 50.90 and 10 CFR 50.91(a)(6), the Omaha Public Power District (OPPD) hereby proposes to amend Fort Calhoun Station (FCS), Unit No. 1, Renewed Facility Operating License No. DPR-40 by revising the current licensing basis (CLB) pertaining to protection from tornadoes and tornado-generated missiles. Specifically, OPPD proposes to revise the Updated Safety Analysis Report (USAR) for compliance with the following elements comprising the methodology being adopted and used to address the design-basis tornado (DBT) and tornado missiles:

- Regulatory Guide (RG) 1.76, Revision 1, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” (Reference 2). The RG provides the DBT and DBT missile input parameters for the region of the United States that FCS is located in. Section C of RG 1.76, Revision 1 establishes the regulatory position for licensees to use in selecting the DBT and DBT-generated missiles that a nuclear power plant should be designed to withstand to prevent undue risk to public health and safety.
- Bechtel Power Corporation, Topical Report BC-TOP-9A, Revision 2, September 1974, “Design of Structures for Missile Impact,” (Reference 3), which provides a methodology approved by the Atomic Energy Commission (AEC) for evaluating the impact of tornado missiles. The Bechtel Topical Report provides an approved methodology for evaluating the RG 1.76, Revision 1 missile population on FCS structures, systems, and components.

These elements comprise the new methodology addressing the DBT and DBT missiles.

Replacing the CLB for tornado and tornado missiles with that of RG 1.76, Revision 1 allows for the consideration of the vertical velocity component of tornado missiles, which the CLB does not and thus for which adequate protection may be lacking. Changing the CLB to RG 1.76, Revision 1 allows designated structures, systems, and components (SSCs) to be analyzed and where necessary, protected by barriers against the RG 1.76 DBT and DBT missiles. This ensures that the plant can reach safe shutdown and be maintained in a safe shutdown condition during a tornado in accordance with Appendix G, Criterion 2, of the USAR.

Adopting Bechtel Topical Report BC-TOP-9A provides an NRC-approved methodology for determining the impact of tornado missiles on structures, systems, and components. This methodology will replace the existing methodology, NAV DOCKS P-51 (August 1950), (Reference 4), which was developed by the Bureau of Yards and Docks, to evaluate the impact of an atomic weapon and the blast-generated missiles on structures. NAV DOCKS P-51 was designed and approved for use by the Atomic Energy Commission (AEC) for this function.

The Enclosure justifies changing the CLB for tornadoes and tornado missiles to RG 1.76, Revision 1, and Bechtel Topical Report BC-TOP-9A, Revision 2. Attachment 1 of the Enclosure explains the reason for the exigency, Attachment 2 contains USAR page markups, and Attachment 3 contains the revised USAR pages with changes denoted by revision bars in the right margin.

This license amendment request (LAR) has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c). OPPD has determined that this LAR involves no significant hazards consideration. The basis for this determination is included in the Enclosure.

OPPD requests this LAR be processed as an exigent change and approved within 7 days from the date of submittal in order to minimize the impact on plant restart. The license amendment will be implemented upon approval.

In accordance with 10 CFR 50.91, a copy of this application, with attachments, is being provided to the designated State of Nebraska official.

No commitments to the NRC are contained in this submittal.

If you have any additional questions, or require further information, please contact Mr. Bill R. Hansher at (402) 533-6834.

I declare under penalty of perjury that the foregoing is true and correct; executed on July 21, 2013

Sincerely,

Louis P. Cortopassi
Site Vice President and CNO

LPC/JAC/mle

Enclosure: OPPD's Evaluation of the Proposed Change(s)

c: A. T. Howell, NRC Regional Administrator, Region IV
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OPPD's Evaluation of the Proposed Change(s)

Exigent License Amendment Request 13-02 Revising Current Licensing Basis Regarding Tornado Missiles

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ATTACHMENTS:

1. Basis for Exigent Circumstances and Request for Approval Under 10 CFR 50.91(a)(6)
2. USAR Pages – Page Markups
3. USAR Pages – Clean Pages

1.0 SUMMARY DESCRIPTION

The Omaha Public Power District (OPPD) hereby requests an exigent amendment to Fort Calhoun Station (FCS), Unit No. 1, Renewed Facility Operating License No. DPR-40. Specifically, OPPD proposes to change the current licensing basis (CLB) described in the Updated Safety Analysis Report (USAR) to require compliance with the following elements that comprise the methodology being adopted and used to address the design-basis tornado (DBT) and tornado missiles:

- Regulatory Guide (RG) 1.76, Revision 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," (Reference 6.1). The RG provides the DBT and DBT missile input parameters for the region of the United States that FCS is located in. Section C of RG 1.76, Revision 1 establishes the regulatory position for licensees to use in selecting the DBT and DBT-generated missiles that a nuclear power plant should be designed to withstand to prevent undue risk to public health and safety.
- Bechtel Power Corporation, Topical Report BC-TOP-9A, Revision 2, September 1974, "Design of Structures for Missile Impact," which provides a methodology approved by the Atomic Energy Commission (AEC) for evaluating the impact of tornado missiles (Reference 6.9). The Bechtel Topical Report provides an approved methodology for evaluating the RG 1.76, Revision 1 missile population on FCS structures, systems, and components.

These elements comprise the new methodology to address the DBT and tornado missiles. NRC approval of this change to the CLB is necessary as these documents update the characteristics of the DBT and associated missiles and analysis thereof from that which the plant was licensed.

Attachment 1 explains the exigent nature of this license amendment request (LAR).

2.0 DETAILED DESCRIPTION

Section C, Regulatory Position of RG 1.76 states:

The NRC staff has established the following regulatory positions for licensees and applicants to use in selecting the design-basis tornado and design-basis tornado-generated missiles that a nuclear power plant should be designed to withstand to prevent undue risk to the health and safety of the public.

1. Design-Basis Tornado Parameters

Nuclear power plants should be designed to withstand the design-basis tornado. The parameter values specified in Table 1 for the appropriate regions identified in Figure 1 are generally acceptable to the NRC staff for defining the design-basis tornado for a nuclear power plant. If a design-basis tornado proposed for a given site is characterized by less-conservative parameter values than the regional values in Table 1, a comprehensive analysis should be provided to justify the selection of the less-conservative design-basis tornado. Sites located near the general boundaries of adjoining regions may involve additional considerations. The radius of maximum rotational speed of 45.7 meters (150 feet) is used for all three tornado intensity regions.

2. Design-Basis Tornado-Generated Missile Spectrum

The design-basis tornado-generated missile spectrum in Table 2 is generally acceptable to the staff for the design of nuclear power plants.

OPPD's implementation of the Criteria of RG 1.76, Section C.1 and C.2 allows designated SSCs to be analyzed and where necessary, protected by barriers against the RG 1.76 DBT and DBT missiles. This ensures that the plant can reach safe shutdown and be maintained in a safe shutdown condition during a tornado as required by USAR Appendix G, Criterion 2. These actions enhance the protection of public health and safety as they consider aspects of tornado-generated missiles (i.e., the vertical velocity component) not previously addressed in the FCS CLB. However, as certain aspects of the RG 1.76 DBT (e.g., wind speed) are less severe than that described in the FCS USAR, NRC approval is necessary to change the CLB regarding tornadoes and tornado missiles.

Per RG 1.76, Revision 1, the automobile missile is considered to impact at all altitudes less than 30 feet above all grade levels within 0.5 miles of plant structures. Portions of the entrance road near Highway 75 are within 0.5 miles of plant structures and are at or slightly above 1,070 feet mean sea level (MSL). The site entrance road decreases in elevation as it approaches the protected area from Highway 75. However, the roof of the auxiliary building at 1,044 feet MSL is a potential target for the RG 1.76 automobile missile launched from the access control point. The protected area and parking lots around it are at a much lower elevation that does not make the auxiliary building roof a target for the RG 1.76 automobile missile. The automobile missile will be eliminated from consideration by procedural controls implemented during a severe thunderstorm warning or tornado watch/warning or mitigated by analysis.

Specifically, OPPD proposes to incorporate new USAR Section 2.5.2.8, "Tornadoes" and revise USAR Sections 5.4.7, "Tornado Loading," and 5.8.2.2, "Tornado Generated Missiles." The markup of USAR Section 2.5.2.8 discusses compliance with RG 1.76 (Reference 6.1) for the protection of designated SSCs against the characteristics of the RG 1.76 DBT and DBT missiles. Section 5.4.7 is revised to apply the DBT characteristics from RG 1.76. Section 5.8.2.2 discusses compliance with RG 1.76 and the use of BC-TOP-9A Revision 2 as the analysis methodology. These revisions ensure that designated SSCs are protected against the characteristics of the RG 1.76 DBT and DBT missiles and provide details regarding the newly adopted DBT missiles from RG 1.76 Table 2.

The changes to USAR Section 2.5.2.8, USAR Section 5.4.7, and USAR Section 5.8.2.2 for which NRC approval is sought are found in Attachments 2 and 3. Attachment 2 contains the markup of these sections showing new text in double underline and deleted text in ~~strikeout~~. Attachment 3 contains the revised (i.e., clean) pages showing the text with revision bars in the right margin denoting where changes were made. NRC approval of the changes to these USAR Sections will form the basis for revising additional USAR Sections (e.g., Section 5.11, Appendix G, etc.) to incorporate specific information regarding the protection of designated SSCs in accordance with RG 1.76.

3.0 TECHNICAL EVALUATION

The original licensing of FCS pre-dated much of the regulatory framework that exists today, including design methodologies for evaluating the impact of tornados and tornado missiles on structures, systems, and components. In order to determine how tornado missiles would impact FCS, NAV DOCKS P-51 (Reference 6.11), which was developed to assist in the protective design of structures to withstand atomic weapons was utilized.

The adoption of Bechtel Topical Report BC-TOP-9A, Revision 2 (Reference 6.9) changes the evaluation methodology to one that was specifically intended to address the impact of tornado missiles on nuclear power facilities. Bechtel Topical Report BC-TOP-9A was approved via an AEC Topical Report (Reference 6.10) which is included in the methodology. Therefore, it is appropriate to utilize the Bechtel Topical Report BC-TOP-9A guidance for the assessment of tornado missiles on nuclear plant structures to analyze, design, and install physical modifications ensuring the protection of the public health and safety.

The results of Bechtel Topical Report BC-TOP-9A, Revision 2 on the impact of tornado missiles on structures, systems, and components will be utilized to ensure that the requirements of Draft GDC 2 (Reference 6.8) are maintained. Fort Calhoun Station was licensed for construction prior to May 21, 1971, and at that time committed to the draft General Design Criteria (GDC). The draft GDC are contained in Appendix G (Reference 6.8) of the FCS USAR and are similar to 10 CFR 50 Appendix A, *General Design Criteria for Nuclear Power Plants*. The draft GDC that pertains to tornadoes is USAR Appendix G, Criterion 2, *Performance Standards*.

RG 1.76 will define postulated missiles, such as striking velocity, weight, configuration etc. The Bechtel Topical Report is used as the procedure for developing the design criteria.

Tornadoes

In RG 1.76, Revision 1, the NRC determined that the design-basis tornado wind speeds for new reactors should correspond to the exceedance frequency of 10^{-7} per year (calculated as a best estimate), thus using the same exceedance frequency as the original version of RG 1.76. The results of the analysis indicated that a maximum wind speed of 103 meters per second (m/s) [230 miles per hour (mph)] is appropriate for tornadoes in that part (i.e., Region I) of the United States where FCS is located. Table 1 of RG 1.76 shows that the DBT in Region I causes a pressure drop of 1.2 pounds per square inch (psi) in 0.5 seconds (Reference 6.1).

In contrast, USAR Section 5.4, “Containment Loading” states that the containment structure was designed to maintain its structural integrity and thus permit a safe shutdown in a tornado with a maximum wind velocity of 500 mph. A concurrent pressure drop of three (3) psi applied in a period of three (3) seconds was assumed as the tornado passes across the structure. USAR Section 5.11, “Structures Other Than Containment,” states that Class I structures, other than the containment, were designed to withstand a tornado with a maximum wind velocity of 300 mph and a concurrent pressure drop of three (3) psi applied in a period of three (3) seconds as the tornado passes across the building.

USAR Section 5.11 states that the grade slab of the auxiliary building was designed to support falling debris that might result from tornado wind speeds in excess of the structure's design wind speed of 300 mph. The emergency diesel generator enclosure and the spent fuel pool structure were designed to withstand a tornado with a maximum wind velocity of 500 mph, and thus have additional margin beyond the 300 mph value. During the original design of FCS, data on actual tornado velocities was not available, due to the destruction of the associated test equipment upon the passing of the tornado. Due to this lack of data, values well in excess of the now-available data were selected.

Thus, the tornado presently described in the USAR, which the Class I structures at FCS were designed to withstand, is more severe and therefore bounding of the DBT assumed by RG 1.76. However, analyzing and installing physical modifications using tornado and tornado missile characteristics presently described in the USAR would be based on outdated and overly conservative assumptions without commensurate safety benefit.

RG 1.76 indicates that a DBT with the characteristics described therein has only a 1 in 1,000,000 chance of impacting a particular site. The characteristics of the RG 1.76 DBT are based on significantly more data than was available when FCS was licensed. For example, Section 5.4.7, "Tornado Load" of the FCS Final Safety Analysis Report (the predecessor to the FCS USAR) states: "Definitive data regarding loadings actually experienced during tornadoes are not presently available; this lack of information is primarily due to the destruction of recording instruments at the time of maximum wind velocities."

Therefore, it is appropriate to utilize updated guidance for the characteristics of the DBT and DBT missiles as provided in RG 1.76 to analyze, design, and install physical modifications ensuring the protection of public health and safety.

Tornado Missiles

The properties of the RG 1.76 missiles are shown in Table 1 below and the properties of the CLB missiles as described in Table 5.8-2 of USAR Section 5.8 (Reference 6.3) are shown in Table 2 below.

Missile Type	**Dimensions**	**Mass (lbs.)**	**C_DA/m ft^2/lb**	**V_{Mh}^{max} ft/s**
Schedule 40 Pipe	6.625" dia. x 15' long	287	0.0212	135
Automobile	16.4' x 6.6' x 4.3'	4,000	0.0343	135
Sphere	1" dia	0.147	0.0166	26

Table 1. RG 1.76 Missiles

Missile Type	Dimensions	Mass (lbs.)	Impact Area ft^2	V_{Mh}^{max} ft/s
3" pipe	3" dia x 10' long	76	0.095	640
Plank	4" x 12" x 12' long	104	0.29	710
Automobile	N/A	4,000	31.5	665

Table 2. CLB Missiles

Automobile Missile

The mass of the RG 1.76 automobile missile and the CLB automobile missile are identical. However the horizontal velocity of the CLB automobile missile greatly exceeds that assumed by RG 1.76. Although Class I structures are designed to withstand impact from the horizontal velocity component of the CLB automobile missile, the CLB does not take into account the vertical velocity component of such missiles nor does it assume they are lifted 30 feet into the air from the highest elevation within 0.5 miles of the site as required by RG 1.76. It is appropriate to revise the CLB to require that designated SSCs be protected against the RG 1.76 DBT automobile missile because that requires consideration of the vertical velocity component of such missiles, an aspect not considered by the CLB. Similarly, it is appropriate to revise the CLB to account for the lower velocity of the RG 1.76 DBT automobile missile.

The automobile missile is eliminated from consideration by procedural controls implemented during a severe thunderstorm warning or tornado watch/warning or mitigated by analysis. These controls do not permit the parking of automobiles in the areas of consideration (i.e. elevations high enough to impact the auxiliary building roof under RG 1.76 assumptions) or in the case of the access road and access control point prompt actions are taken by security officers to deny automobile access to the site during severe thunderstorms or tornado watches/warnings.

Schedule 40 Pipe

The mass of the RG 1.76 schedule 40 pipe is much greater than the CLB pipe. However the horizontal velocity of the CLB pipe greatly exceeds that assumed by RG 1.76. Although Class I structures are designed to withstand impact from the horizontal velocity component of the CLB pipe, the CLB does not take into account the vertical velocity component of such missiles. It is appropriate to revise the CLB to require that designated SSCs be protected against the RG 1.76 DBT pipe missile because that requires consideration of the vertical velocity component of such missiles, an aspect not considered by the CLB. Similarly, it is appropriate to revise the CLB to account for the greater mass and lower velocity of the RG 1.76 DBT pipe missile.

Sphere

The CLB does not have a tornado missile equivalent to the RG 1.76 sphere, which is intended to test the configuration of openings in protective barriers. Therefore, it is appropriate to revise the CLB to require that designated SSCs be protected against the vertical and horizontal velocity components of the RG 1.76 sphere.

Plank

RG 1.76 does not contain criteria for a plank missile as the CLB presently does. However, the RG 1.76 Schedule 40 pipe missile has similar dimensions as the plank missile but much greater mass. Thus, it is reasonable to assume that protection that is adequate for the RG 1.76, Schedule 40 pipe missile would also be adequate protection for the CLB plank missile. Based on the DBT and DBT missile velocities assumed by RG 1.76, the plank's velocity would be much lower than stated in the CLB. USAR Section 5.11 also notes that the most critical missile listed in Section 5.8.2.2 is the 3" diameter pipe and not the plank.

In summary, the Class I structures at FCS were designed to withstand the tornado and tornado missiles presently described in the USAR to enable the plant to reach safe shutdown and be maintained in a safe shutdown condition during a tornado. However, the RG 1.76 missiles are based on more current data regarding the DBT and with the exception of the sphere, the RG 1.76 missiles, and USAR Section 5.8 missiles have similar physical characteristics. RG 1.76 also shows that the CLB significantly overstates tornado missile velocities. Public health and safety will be protected by the installation of physical modifications or performing appropriate analyses and/or evaluations designed to protect designated SSCs against the RG 1.76 DBT missiles in lieu of the CLB missiles presently described in the USAR. The application of RG 1.76 DBT and DBT missiles in lieu of the present CLB will continue to ensure that the plant can reach safe shutdown and be maintained in a safe shutdown condition during a tornado.

In 2011, the NRC approved a similar request from the Tennessee Valley Authority (TVA) for Watts Bar Nuclear Plant, Unit 2 (Reference 6.4). TVA updated the design conditions assumed for the WBN reactor shield building and other safety-related structures to be consistent with the appropriate guidance in RG 1.76, Revision 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," issued March 2007. This was a revision from the planned original design basis for WBN Unit 2, which was consistent with Revision 0 of RG 1.76 issued in April 1974. The NRC noted that the change reflected the use of the updated guidance and was acceptable.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

4.1.1 Regulations

For stationary power reactor site applications submitted on or after January 10, 1997, paragraph 100.20(c)(2) of 10 CFR Part 100 requires meteorological characteristics of the site that are necessary for safety analysis or may have an impact upon plant design (such as maximum probable wind speed) must be considered in determining the acceptability of a site for a nuclear power plant. In addition, paragraph 100.21(d) of 10 CFR Part 100 requires that the physical characteristics of the site, including meteorology, must be evaluated and site parameters established such that potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site (Reference 6.1).

OPPD is not submitting an application for a stationary power reactor site, however, it is appropriate that the requirements of 10 CFR Part 100 described above be taken into account in this request to change the CLB described in the USAR. RG 1.76 provides a basis for compliance with the requirements of 10 CFR Part 100.

General Design Criteria:

Fort Calhoun Station was licensed for construction prior to May 21, 1971, and at that time committed to the draft General Design Criteria (GDC). The draft GDC are contained in Appendix G (Reference 6.8) of the FCS USAR and are similar to 10 CFR 50, Appendix A, *General Design Criteria for Nuclear Power Plants*. The draft GDC that pertains to tornadoes is USAR Appendix G, Criterion 2, *Performance Standards*. Criterion 40, which pertains to internally generated missiles, is also shown below.

CRITERION 2 - PERFORMANCE STANDARDS [Pertinent text shown below]

Those systems and components of reactor facilities which are essential to the prevention of accidents which could affect public health and safety or to mitigation of their consequences shall be designed, fabricated, and erected to performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice and other local site effects. The design bases so established shall reflect: (a) Appropriate consideration for the most severe of these natural phenomena that have been recorded for the site and the surrounding area and (b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design.

This criterion is met. The systems and components of the Fort Calhoun Station, Unit No. 1 reactor facility that are essential to the prevention or mitigation of accidents that could affect public health and safety are designed, fabricated, and erected to withstand without loss of capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, floods, winds, ice and other local site effects.

The containment will be designed for simultaneous stresses produced by the dead load, by 60 psig internal pressure at the associated design temperature, and by the application of forces resulting from an earthquake whose ground motion is 0.08g horizontally and 0.053g vertically. Further, the containment structure will be designed to withstand a sustained wind velocity of 90 mph in combination with the dead load and design internal pressure and temperature conditions. The wind load is based on the highest velocity wind at the site location for 100-year period of recurrence: 90 mph base wind at 30 feet above *ground level. Other Class I structures will be designed similarly except that no internal pressure loading is applicable. Class I systems will be designed for their normal operating loads acting concurrently with the earthquake described above.*

The facility is designed so that the plant can be safely shutdown and maintained in a safe shutdown condition during a tornado. Design considerations associated with tornadoes are further explained in Section 5.4.7 of the USAR.

<u>CRITERION 40 – MISSILE PROTECTION</u>

Protection for engineered safety features shall be provided against dynamic effects and missiles that might result from plant equipment failures.

This criterion is met. The high-pressure equipment in the reactor coolant system is surrounded by reinforced concrete and steel structures designed to stop all credible missiles and withstand the forces generated in a loss-of-coolant accident for break sizes up to and including the double-ended rupture of the reactor coolant pipe. The containment liner, the reactor coolant loops, the steam and feedwater piping, the auxiliary cooling piping and the containment cooling system are protected from missiles generated within the containment building. Barriers are provided where the use of radiation shielding and/or support structures for missile shielding is not feasible.

Two of the containment air recirculation and cooling units are located on the operating floor, and two on a concrete platform above the first pair. They are protected from missiles by the walls of the reactor coolant equipment compartments and by the missile shield placed over the reactor. Auxiliary coolant enters the air handling unit from below the operating floor, so that it is remote from any missiles.

The most critical plant missile external to the auxiliary and containment buildings has been determined to be a turbine last stage wheel fragment. Analyses and associated inspection and testing ensure that the probability of unacceptable damage from turbine missile strikes meets the specified criteria.

The emergency core cooling system is designed to prevent loss of design capability during the emergency of a pipe rupture or earthquake. Piping connecting vessels is engineered to restrict movement to certain maximum values during these emergencies. The piping system is designed to accept these emergency imposed movements and still remain within code allowable limits for stress. Flexibility calculations are according to the Code for Nuclear Piping, United States of America Standards Institute (USASI) B31.7.

At Fort Calhoun, Class I structures designed to withstand a tornado event are in place to ensure that a tornado will not result in a Chapter 14 accident (e.g., loss-of-coolant accident or main steam line break). This addresses the requirement of: prevention of accidents which could affect public health and safety or mitigation of their consequences. Through the prevention of accidents, mitigation is not required. Additionally, the plant design basis (as presented in both the original licensing documents and the CLB) is to achieve and maintain safe shutdown following a tornado event. Therefore, the ability to safely shutdown the plant following a tornado event is a USAR described design feature but is not associated with any USAR Chapter 14 accident.

Replacing the CLB regarding tornadoes and tornado missiles with the DBT and DBT missiles described in RG 1.76 does not impact the ability to comply with USAR Appendix G, Criterion 2. The plant will continue to be able to reach safe shutdown and be maintained in a safe shutdown condition during a tornado.

This change also does not impact the ability to comply with Criterion 40, which is directed at missiles generated by plant equipment failures rather than tornadoes.

4.1.2 Design Basis (USAR)

The pertinent aspects of tornadoes and tornado missiles and their effect on Class I structures as presently contained in the USAR are described below. Following NRC approval of this LAR, the criteria of RG 1.76, Revision 1 will be utilized for the DBT and DBT missiles to ensure that the plant can reach safe shutdown and be maintained in a safe shutdown condition during a tornado.
USAR Appendix F (Reference 6.5), notes that Class I structures include containment, the auxiliary building, and the intake structure. Structures and components designated Class I (not to be confused with ASME Class I) are those whose failure might cause or increase the severity of an accident that could result in an uncontrolled release of radioactivity. Structures and components vital to safe shutdown and isolation of the reactor are also included in the Class I classification. All other structures and components are classified as Class II.

USAR Section 5.4.7 (Reference 6.6), notes that the containment structure was designed to maintain its structural integrity and thus permit a safe shutdown in a tornado with a maximum wind velocity of 500 miles per hour. A concurrent pressure drop of three (3) psi applied in a period of three (3) seconds was assumed as the tornado passes across the structure. In addition, the containment structure can withstand the torsional moment resulting from the drag of peripheral winds of 500 mph at the entire surface of the cylindrical wall exterior. The containment shell is also resistant against the impact effect of hypothetical tornado-borne missiles as discussed in Section 5.8.2.2.

USAR Section 5.11, (Reference 6.7), notes that Class I structures were designed to ensure that their functional integrity under the most extreme environmental loadings, such as tornadoes or maximum hypothetical earthquake, will not be impaired and thereby, prevent a safe shutdown of the plant. Class I structures, other than the containment, were designed to withstand a tornado with a maximum wind velocity of 300 miles per hour and a concurrent pressure drop of three (3) psi applied in a period of three (3) seconds as the tornado passes across the building. Sufficient venting was provided to prevent the differential pressure, during depressurization, from exceeding a 1.5 psi design value.

USAR Section 5.11 notes that the grade slab of the auxiliary building was designed to support falling debris that might result from tornado wind speeds in excess of the above structures design wind speed of 300 mph so as to provide additional margin. The emergency diesel generator enclosure and the spent fuel pool structure were designed to withstand the tornado with a maximum wind velocity of 500 miles per hour, and thus have additional margin beyond the 300 mph basis value. The 300 mph and 500 mph maximum wind velocities specified in the USAR were considered to be the sums of the translational and rotational components of the tornado. The tornado wind loads were distributed throughout the structures in accordance with ASCE paper No. 3269, Transactions of the American Society of Civil Engineers, Part II, 1961, utilizing a uniform load throughout the height of the structures.

USAR Section 5.11 also notes that Class I structures were designed to withstand the spectrum of tornado generated missiles, listed in Section 5.8.2.2, the most critical of which is a 3" diameter pipe 10' long moving at a velocity of 640 feet per second.

4.1.3 Approved Methodologies

- NRC Standard Review Plan (NUREG-0800) Section 3.5.1.4 Revision 3, *Missiles Generated by Tornadoes and Extreme Winds*, March 2007
- NRC Regulatory Guide 1.76 Revision 1, Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants, March 2007
- NRC Standard Review Plan (NUREG-0800) Section 3.5.3 Revision 3, Barrier Design Procedure, March 2007
- Letter from Atomic Energy Commission, R.W. Klecker, Technical Coordinator for Light Water Reactors Group 1 Directorate of Licensing, to John V. Morowski, Vice President-Engineering, Bechtel Power Corporation, November 25, 1974, approving the use of Bechtel Topical Report BC-TOP-9A.

4.2 <u>Precedent</u>

NUREG-0847, Supplement 22, Safety Evaluation Report, Related to the Operation of Watts Bar Nuclear Plant, Unit 2, published February 2011 (ML110390197)

4.3 <u>Significant Hazards Consideration</u>

The Omaha Public Power District (OPPD) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed change to the current licensing basis (CLB) utilizes current NRC guidance (i.e., Regulatory Guide (RG) 1.76, Revision 1), regarding the characteristics of the design basis tornado (DBT) and associated missiles and NRC-approved methodology (i.e., Bechtel Topical Report BC-TOP-9A, Revision 2) for the analysis thereof. These NRC-approved documents will form the basis for ensuring that recently identified tornado missile targets are adequately protected.

The proposed change does not increase the probability or consequences of an accident previously evaluated. The proposed change is more comprehensive than the CLB as it will require consideration of the vertical velocity component of DBT missiles, and use an approved methodology BC-TOP-9A for analyzing tornado missile impact. This will provide a basis for analyzing and protecting designated SSCs using protective barriers to enable the plant to reach safe shutdown and be maintained in a safe shutdown condition during a tornado.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. **Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?**

Response: No.

The proposed amendment provides the regulatory basis for changing the CLB to require compliance with RG 1.76, Revision 1 for the DBT and associated missiles, and use an approved methodology BC-TOP-9A for analyzing tornado missile impact. The proposed amendment does not involve a change in methods governing plant operation. The proposed amendment requires consideration of the vertical velocity component of DBT missiles not presently required by the CLB. Designated SSCs are protected by barriers against the RG 1.76, Revision 1 DBT and associated missiles to ensure the plant can reach safe shutdown and be maintained in a safe shutdown condition during a tornado.

No new interactions between systems or components are created. No new failure mechanisms of associated systems will exist. The proposed amendment ensures that designated SSCs are protected from the effects of the DBT and associated missiles in accordance with current NRC guidance.

Therefore, the amendment does not create the possibility of a new or different kind of accident from any previously evaluated.

3. **Does the proposed amendment involve a significant reduction in a margin of safety?**

Response: No.

The proposed amendment provides the regulatory basis for changing the CLB to utilize updated NRC guidance regarding the characteristics of the DBT and associated missiles. Designated SSCs are protected in accordance with the most recent NRC guidance and approved methodologies as documented above regarding the characteristics of the DBT and DBT missiles and how to analyze their impact on structures, systems and components. The proposed amendment does not alter the manner in which safety limits or limiting safety system settings are determined. The safety analysis acceptance criteria are not affected by the proposed amendment. Further, the proposed amendment does not change the design function of any equipment assumed to operate in the event of an accident. The proposed change provides a basis for protecting designated SSCs in accordance with current NRC guidance and approved methodologies to enable the plant to reach safe shutdown and be maintained in a safe shutdown condition during a tornado.

Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

Based on the above, OPPD concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.4 <u>Conclusions</u>

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

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure.

Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

6.1 Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1, dated March 2007

6.2 NRC Regulatory Information Summary 2013-05 "NRC Position on the Relationship between General Design Criteria and Technical Specification Operability," dated May 9, 2013

6.3 USAR-5.8, "Missile Protection and Pipe Whipping Restraints"

6.4 NUREG-0847, "Supplement 22, Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Published February 2011 (ML110390197)

6.5 USAR-Appendix F, "Classification of Structures and Equipment and Seismic Criteria"

6.6 USAR-5.4.7, "Containment Loading"

6.7 USAR-5.11, "Structures Other than Containment"

6.8 USAR-Appendix G, "Responses to 70 Criteria"

6.9 Bechtel Topical Report BC-TOP-9A, "Design of Structures for Missile Impact", Revision 2, September 1974

6.10 Letter from Atomic Energy Commission, R.W. Klecker, Technical Coordinator for Light Water Reactors Group 1 Directorate of Licensing, to John V. Morowski, Vice President-Engineering, Bechtel Power Corporation, November 25, 1974

6.11 NAV DOCKS P-51, "Design of Protective Structures," (A New Concept of Structural Behavior), Arsham Amirikian, Presented at the Annual Meeting of the American Society of Civil Engineers in Chicago IL, October 11-14, 1950) Bureau of Yards and Docks, Department of the Navy, August, 1950 (Unclassified)

Basis for Exigent Circumstances and Request for Approval under the Requirements of 10CFR50.91(a)(6)

As required by 10 CFR 50.91(a)(6)(vi) licensees requesting approval of amendments to the operating license under exigent circumstances must explain the exigency and why the licensee cannot avoid it. Below are the reasons for the unavoidable exigent circumstances for Fort Calhoun Station (FCS), Unit No. 1.

The Reason for the Exigency and Why the Need for the Requested Action Could Not Reasonably Have Been Identified

On April 22, 2013, representatives of the Omaha Public Power District (OPPD) held a public meeting with Nuclear Reactor Regulation (NRR) staff to discuss the need for potential license amendments. Tornado missile targets was one of the issues discussed. At that meeting, OPPD noted that the raw water (RW) pump pull box target would be addressed by installing a modification prior to core reload and that the other tornado missile targets would be addressed by installing similar modifications prior to plant restart. OPPD also briefed the staff on its plan to submit a license amendment request after plant restart that would change the current licensing basis regarding tornado and tornado missile characteristics to adhere to those described in Regulatory Guide (RG) 1.76, Revision 1. At the time, OPPD understood this approach to be satisfactory to the staff.

However, subsequent to the April 22, 2013 public meeting, it was recently determined that in addition to the modifications discussed at the meeting, the tornado wind velocities assumed in the current licensing basis were overly conservative in comparison to current NRC guidance (i.e., RG 1.76, Revision 1). Within the last several weeks, additional tornado missile vulnerabilities have been identified, and are being aggressively corrected through the modification process. Discussions between OPPD and the NRC have concluded that a license amendment must be obtained to support plant startup. Due to the complex and integrated nature of the activities required to recover from an extended outage, an extended delay in a key activity would have a cascading, adverse impact. This will allow OPPD to document that the physical modifications to the RW pull boxes and other identified targets were performed in accordance with NRC-approved methodologies (i.e., RG 1.76, Revision 1, and Bechtel Topical Report BC-TOP-9A, Revision 2).

Updated Safety Analysis Report (USAR)
Page Markups

USAR-2.5

Site and Environs

Meteorology

Rev 11

Safety Classification:

Safety

Usage Level:

Information

Change No.:	**EC**
Reason for Change:	
Preparer:	
Owner:	
Issued:	

Fort Calhoun Station

2.5.2.7 Topographical Description and Its Influence on Site Meteorology

The terrain in the vicinity of Fort Calhoun Station is generally flat from the north, northeast, east and southeast sectors, with an elevation of approximately 1000 feet above mean sea level (msl), for a radius of at least 10 miles. This terrain is generally the flood plain of the Missouri River. Terrain in the remaining sectors, south-southeast through west-northwest show much greater relief from the low lying bluffs, cut by numerous ravines, with elevations of about 1300 feet above msl. These bluffs extend along the western bank of the Missouri River, which runs generally from the northwest to the southeast, and come within about one mile of the Fort Calhoun Station in the south through west-southwest sectors.

Two unusual effects in the site meteorology are: 1) under very light westerly wind flow there is a possibility of weak drainage flow off the bluffs to the west toward the river, and 2) there will possibly be a slowing down of weak winds as air flows across the river from east to west and meets the rising terrain to the west. However, neither of these effects are regarded as significant in their influence on site meteorology and should not, under most synoptic weather types, severely skew the strong measures of covariation (+0.75 to +1.00) which exist between the site and other meteorological stations.

2.5.2.8 Tornadoes

USAR, Appendix G, Criterion 2, “Performance Standards” requires the facility to be designed so that the plant can be safely shutdown and maintained in a safe shutdown condition during a tornado.

The physical design parameters of tornado protection systems are such that designated SSCs are able to maintain their necessary capabilities in the event of a Design Basis Tornado (DBT). Amendment XXX[Reference 37] revised the DBT and associated tornado missiles for Fort Calhoun Station (FCS) to that defined in Regulatory Guide (RG) 1.76, Revision 1[Reference 38]. This ensures that designated SSCs are adequately protected from the DBT and associated tornado missiles.

Designated SSCs are either protected by barriers to preclude tornado damage or where protective barriers are not installed, the structures and components themselves are designed to withstand the effects of the DBT, including DBT missile strikes. Tornadoes have the potential to generate a large number of missiles whose path is unpredictable. As a result, the physical separation of SSCs by itself (i.e., lacking additional protective measures) is not adequate to mitigate the effects of tornadoes.

At Fort Calhoun Station, designated SSCs are designed or protected to withstand the effects of the RG 1.76, Revision 1 DBT without losing the capability to perform their safety function. This ensures that the plant can be safely shutdown and maintained in a safe shutdown condition during a tornado.

Tornado Missiles

The physical properties and velocities of tornado generated missiles are described in USAR Section 5.8.2.2.

USAR-5.4

Structures

Containment Loading

Rev 7

Safety Classification: Safety

Usage Level: Information

Change No.:	
Reason for Change:	
Preparer:	
Issued:	

5.4.5 Design Exterior Pressure

The design exterior pressure was 2.5 psi. This is the positive differential pressure between the outside and the inside of the containment and would be realized under the following sequence of atmospheric and operational events:

a. The containment structure is sealed while the internal temperature is 120°F and the external barometric pressure is 29.0 inches of mercury;

b. The containment is then cooled so that the internal temperature becomes 80°F with a simultaneous increase in external barometric pressure to 31.0 inches of mercury.

5.4.6 Wind Load

The wind load was based on the recommendations of ASCE Paper 3269, "Wind Forces on Structures." The fastest mile of wind at the site location for a 100 year period of recurrence is a 90 mph basic wind at 30 feet above ground level. Shape and gust factors and wind velocity variations with heights were employed from the same reference. Containment structure wind loading diagrams are shown in Figure 5.4-2.

5.4.7 Tornado Load

The containment structure ~~was~~ is designed to maintain its structural integrity and thus permit a safe shutdown in a tornado with a maximum wind velocity of ~~500~~ 230 miles per hour. A concurrent pressure drop of ~~3~~ 1.2 psi applied ~~in a period of 3 seconds was~~ at a rate of 0.5 psi per second is assumed as the tornado passes across the structure.

In addition, the containment structure can withstand the torsional moment resulting from the drag of peripheral winds of ~~500~~ 230 mph at the entire surface of the cylindrical wall exterior.

The containment shell is also resistant against the impact effect of hypothetical tornado-borne missiles as discussed in Section 5.8.2.2.

5.4.8 Seismic Loads

Seismic loads for the containment were based on a design earthquake and a larger maximum hypothetical earthquake as discussed in Appendix F. The simultaneous ground accelerations were:

a. Design earthquake: 0.08g horizontal and 0.053g vertical;

b. Maximum hypothetical earthquake: 0.17g horizontal and 0.113g vertical.

USAR-5.8

Structures

Missile Protection and Pipe Whipping Restraints

Rev 8

Safety Classification:

Safety

Usage Level:

Information

Change No.:	
Reason for Change:	
Preparer:	
Issued:	

The necessary turbine inspection interval is maintained at FCS and consequently, the probability of damage to containment from a turbine-generated missile is less than 1.0 E-7 which is below regulatory concern as a design basis event (NRC Regulatory Guide 1.115).

5.8.2.2 Tornado Generated Missiles

~~As originally licensed, the A spectrum of hypothetical missiles used for the original design basis analysis assumed to that might be generated by tornado winds is shown in Table 5.8-2 below. The missile velocities have been were calculated by using a wind velocity of 500 miles per hour and acceleration distances appropriate to the site. As with the turbine generated missiles, using the present state-of-the-art missile penetration data that was state-of-the art at that time, it is was determined that the Table 5.8-2 tornado generated missiles would not perforate the containment.~~

~~Table 5.8-2 - Tornado Generated Missiles~~

~~Item~~	~~Weight (lbs)~~	~~Impact Area sq. ft.~~	~~Velocity (fps)~~
~~3" pipe x 10 ft. long~~	~~76~~	~~0.095~~	~~640~~
~~4" x 12" plank, 12 ft long~~	~~104~~	~~0.29~~	~~710~~
~~Automobile~~	~~4000~~	~~31.5~~	~~665~~

~~No tornado missile protection is provided for the Control Room Air Conditioning Condensers (Section 9.10) and the Auxiliary Feedwater Pump turbine exhaust due to the low probability of tornado missile damage.~~

The spectrum of hypothetical missiles used for the design basis analysis are described below in Table 5.8-2. The associated design-basis tornado (DBT) characteristics are described below in Table 5.8-3. The criteria shown in Tables 5.8-2 and 5.8-3 are taken from Regulatory Guide (RG) 1.76, Revision 1. Per RG 1.76, Revision 1, Fort Calhoun Station is located in Region I of the United States where at the 10^{-7} per year probability level, the DBT is comprised of 230 mph winds with a concurrent pressure drop of 1.2 psi at a rate of 0.5 psi per second. The horizontal velocity component of tornado generated missiles is applied in all horizontal directions and where applicable, the vertical velocity component is equal to 67% of the horizontal velocity. Required safe shutdown equipment installed external to Class I structures must be protected by appropriate protective barriers or analyzed to ensure that equipment remains available. Required safe shutdown equipment installed inside Class I structures are protected by the structure or installed barriers.

Table 5.8-2 - DBT Missile Spectrum and Maximum Horizontal Speeds (Table 2 of RG 1.76, Revision 1)

Item	Weight (lb.)	Horizontal Velocity (fps)
Sched 40 Pipe (6.625" dia x 15' lg)	287	135
Automobile (16.4'x6.6'x4.3')	4000	135
Solid Steel Sphere (1" dia.)	0.147	26

Table 5.8-3 - Design-Basis Tornado Characteristics (Table 1 of RG 1.76 Revision 1)

Region	Maximum wind speed (mph)	Translational speed (mph)	Maximum rotational speed (mph)	Radius of maximum rotational speed (ft)	Pressure drop (psi)	Rate of pressure drop (psi/s)
I	230	46	184	150	1.2	0.5

The Atomic Energy Commission (AEC) approved Bechtel Topical Report BC-TOP-9A, "Design of Structures for Missile Impacts," Revision 2, which was used to evaluate the spectrum of missiles described in Table 5.8-2 against the SSCs to which they are being applied. (Reference 5-xx)

RG 1.76 Revision 1 and Bechtel Topical Report BC-TOP-9A Revision 2, comprise the methodology used to assess structures, systems and components for the DBT and associated missile impacts.

5.8.3 Pipe Whipping Restraints

Pipe whipping restraints, where deemed necessary, were designed and located to restrict the movement of high pressure piping after rupture to prevent damage to components which might result in a loss of function of a critical system. Critical systems and components requiring protection are those whose failure could increase the severity of an accident and those required for operation after a DBA, for emergency shutdown cooling, and to maintain the integrity of the containment barrier. These critical systems and components are as follows:

a. Safety injection piping (including charging line);

b. Containment spray piping;

c. Auxiliary feedwater piping;

d. Main steam piping upstream of the containment isolation valves;

e. Component cooling water piping serving engineered safeguards equipment;

f. Raw water piping serving engineered safeguards equipment;

g. The containment liner;

h. Containment isolation valves.

Only piping and components subject to possible damage after a high pressure pipe rupture are included in the above listing. Other equipment essential to plant safety (e.g., the containment air cooling units) is not located adjacent to high pressure piping. Piping potentially requiring whipping restraints in the areas of critical piping systems and components is as follows:

- Main steam
- Main feedwater
- Safety injection

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USAR-2.5

Site and Environs

Meteorology

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Safety Classification: Safety

Usage Level: Information

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Fort Calhoun Station

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Tornado Missiles

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USAR-5.4

Structures

Containment Loading

Rev 7

Safety Classification: **Safety**

Usage Level: **Information**

Change No.:	
Reason for Change:	
Preparer:	
Issued:	

Fort Calhoun Station

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5.4.7 Tornado Load

The containment structure is designed to maintain its structural integrity and thus permit a safe shutdown in a tornado with a maximum wind velocity of 230 miles per hour. A concurrent pressure drop of 1.2 psi applied at a rate of 0.5 psi per second is assumed as the tornado passes across the structure.

In addition, the containment structure can withstand the torsional moment resulting from the drag of peripheral winds of 230 mph at the entire surface of the cylindrical wall exterior.

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USAR-5.8

Structures

Missile Protection and Pipe Whipping Restraints

Rev 8

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