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

July 13, 2021

Mr. David Rhoades
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 NOS. 222 AND 222 RE: REVISION OF TECHNICAL SPECIFICATIONS FOR THE ULTIMATE HEAT SINK (EPID L-2021-LLA-0095)

Dear Mr. Rhoades:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 222 to Renewed Facility Operating License No. NPF-72 and Amendment No. 222 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 May 27, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21147A543).

The amendments revise Technical Specifications Surveillance Requirement 3.7.9.2 to allow an ultimate heat sink (UHS) temperature of less than or equal to 102.8 degrees Fahrenheit (°F) until September 30, 2021.

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

Sincerely,

/RA/

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, STN 50-457

Enclosures:
1. Amendment No. 222 to NPF-72
2. Amendment No. 222 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. 222
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 May 27, 2021, 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, the renewed operating license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-72 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 222 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 5 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Nancy L. Salgado

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Date: 2021.07.13 14:20:40 -04'00'

Nancy L. Salgado, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical Specifications
and Renewed Facility Operating License

Date of Issuance: July 13, 2021

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. 222
Renewed License No. NPF-77

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 May 27, 2021, 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, the renewed operating license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-77 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 222 and the Environmental Protection Plan contained in Appendix B, both of which are attached to Renewed License No. NPF-72, dated January 27, 2016, are hereby incorporated into the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 5 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Nancy L. Salgado

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Date: 2021.07.13 14:21:12 -04'00'

Nancy L. Salgado, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical Specifications
and Renewed Facility Operating License

Date of Issuance: July 13, 2021

ATTACHMENT TO LICENSE AMENDMENT NOS. 222 AND 222

RENEWED FACILITY OPERATING LICENSE NOS. NPF-72 AND NPF-77

BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-456 AND STN 50-457

Replace the following pages of the Renewed Facility Operating Licenses and Appendix A, Technical Specifications, with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
License No. NPF-72 Page 3	License No. NPF-72 Page 3
License No. NPF-77 Page 3	License No. NPF-77 Page 3
TSs Page 3.7.9 – 1	TSs Page 3.7.9 – 1

(2) Exelon Generation Company, pursuant to the Act and 10 CFR Part 70, to receive, possess and use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(3) Exelon Generation Company, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Exelon Generation Company, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Exelon Generation Company, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at reactor core power levels not in excess of 3645 megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 222 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(2) Exelon Generation Company, LLC, pursuant to the Act and 10 CFR Part 70, to receive, possess and use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as supplemented and amended;

(3) Exelon Generation Company, LLC, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Exelon Generation Company, LLC, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and

(5) Exelon Generation Company, LLC, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. The renewed license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at reactor core power levels not in excess of 3645 megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 222 and the Environmental Protection Plan contained in Appendix B, both of which are attached to Renewed License No. NPF-72, dated January 27, 2016, are hereby incorporated into the renewed license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3.7 PLANT SYSTEMS

3.7.9 Ultimate Heat Sink (UHS)

LCO 3.7.9 The UHS shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. UHS inoperable due to average water temperature.	A.1 Be in MODE 3. AND A.2 Be in MODE 5.	12 hours 36 hours
B. UHS inoperable for reasons other than Condition A.	B.1 Be in MODE 3. AND B.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.9.1	Verify water level of UHS is ≥ 590 ft Mean Sea Level (MSL).	In accordance with the Surveillance Frequency Control Program
SR 3.7.9.2	Verify average water temperature of UHS is ≤ 102.8°F until September 30, 2021. After September 30, 2021, verify average water temperature of UHS is ≤ 102°F.	In accordance with the Surveillance Frequency Control Program

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 222 TO RENEWED FACILITY OPERATING

LICENSE NO. NPF-72 AND AMENDMENT NO. 222 TO RENEWED FACILITY

OPERATING LICENSE NO. NPF-77

EXELON GENERATION COMPANY, LLC

BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-456, STN 50-457

1.0 INTRODUCTION

By letter, dated May 27, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21147A543), Exelon Generation Company, LLC, (the licensee), requested changes to the Braidwood Station Unit 1 and Unit 2 (Braidwood) Technical Specification (TS) 3.7.9, "Ultimate Heat Sink (UHS)." The proposed changes would modify Surveillance Requirement (SR) 3.7.9.2 to allow a UHS temperature of less than or equal to 102.8 degrees Fahrenheit (°F) until September 30, 2021.

2.0 REGULATORY EVALUATION

2.1 System Description

The UHS consists of an excavated essential cooling pond (ESCP) integral with the main cooling pond. The Updated Final Safety Analysis Report (UFSAR), Revision 18, dated December 17, 2020, Section 2.4.11.6 (ADAMS Accession No. ML21137A265), states that the volume of the UHS is sized to permit the safe shutdown and cooldown of both Braidwood units for a minimum 30-day period during a design basis accident (DBA) without requiring makeup water. The UHS is designed to withstand the separate occurrence of either the safe shutdown earthquake or the probable maximum flood on the cooling pond. The UHS provides a heat sink for process and operating heat from safety-related components during a transient or accident, as well as during normal operation. The licensee states in the UFSAR Section 2.4.1.1 that the ESCP is located in the northwestern corner of the cooling pond in an area excavated below the surrounding pond bottom, to an elevation of 584 feet. The original design of the ESCP is based on a gross surface area of 99 acres and a depth of 6.0 feet at a pool elevation of 590 feet. The post loss-of-coolant accident (LOCA) temperature analysis of the UHS uses a surface area of 95.6 acres at a pool elevation of 590 feet.

The UHS dissipates residual heat after reactor shutdown and after an accident through the cooling components of the essential service water (SX) system and the component cooling (CC) water system, which are the principal systems at Braidwood that utilize the UHS to dissipate residual heat. The UHS also provides a source of emergency makeup water for the spent fuel pool and can provide water for fire protection equipment. Non-essential service water (SW) pumps and circulating water (CW) pumps also take suction from the UHS during normal operation. Operation of the SW and CW pumps for post-accident conditions is not analyzed in the UFSAR since they are shut down before the UHS level reaches the minimum required water level for plant operation at 590 feet.

2.2 Description of the Proposed Changes

The proposed change allows an average UHS temperature of less than or equal to 102.8 °F from the time of approval of this application until September 30, 2021.

Original SR 3.7.9.2:

> Verify average water temperature of UHS is ≤ 102.8 °F until September 30, 2020. After September 30, 2020, verify average water temperature of UHS is ≤ 102 °F.

Revised SR 3.7.9.2:

> Verify average water temperature of UHS is ≤ 102.8 °F until September 30, 2021. After September 30, 2021, verify average water temperature of UHS is ≤ 102 °F.

2.3 Regulatory Requirements and Guidance Used in the Evaluation of the Changes

Licensing Basis Requirements

In the Braidwood UFSAR, Section 3.1.1 (ADAMS Accession No. ML21137A212), the licensee concludes that Braidwood fully satisfies, and is in compliance with the General Design Criteria (GDC). GDC 4, “Cooling Water” is relevant to the change requested by the licensee’s May 27, 2021, letter.

Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.36(c)(2), states that limiting conditions for operation (LCOs) are the lowest functional capability or performance levels of equipment required for safe operation of the facility, and when an LCO is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the TSs until the LCO can be met.

Paragraph 50.36(c)(3) of 10 CFR states that SRs are requirements relating to test, calibration, or inspection, to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the LCOs will be met.

Regulatory Guidance

NUREG-0800 “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [light-water reactor] Edition,” Section 9.2.5, “Ultimate Heat Sink,“

Revision 2, July 1981 (ADAMS Accession No. ML052350549), Section IV, “Acceptance Criteria” and “Evaluation Findings,” contains the following, in part:

> GDC 44, as related to UHS requirements. Acceptance is based upon meeting the guidance of Regulatory Guide 1.27 and demonstrating the capability to transfer heat loads from safety-related SSCs [structure, system, and components] to the heat sink under both normal operating and accident conditions.

3.0 TECHNICAL EVALUATION

The UHS provides a heat sink for the removal of process and operating heat from safety-related components during a transient or accident, as well as during normal operation. The UHS dissipates residual heat after reactor shutdown and after an accident through the cooling components of the SX system and the CC system, which are the principal systems at Braidwood that use the UHS to dissipate residual heat. The UHS also provides a source of emergency makeup water for the spent fuel pool and can provide water for fire protection equipment.

The limit on the UHS pond temperature is meant to restrict the initial UHS temperature such that the maximum temperature of the SX system supplied to the plant safety systems from the UHS experienced during the UHS design basis event would not result in plant equipment cooled by the UHS to operate outside design limits. If the requirement for temperature of the SX system supplied by the UHS exceeds the TS 102 °F limit in the existing TS, then both units would be placed in Mode 3 within 12 hours and Mode 5 within 36 hours.

The SX system takes suction from intake lines running from the Safety Category I ESCP to the auxiliary building where four SX system pumps (two per unit) supply safety-related loads and components essential to safe shutdown. These include cubicle coolers, pump coolers, diesel engine coolers, CC system heat exchangers, reactor containment fan coolers (RCFCs) and chiller condensers.

The CC system provides cooling water to the residual heat removal (RHR) system, chemical and volume control system, reactor coolant system and process sampling system.

In its letter dated May 27, 2021, the licensee states that the limiting DBA includes three sources of heat energy to be transferred by the SX system after a LOCA:

1. containment heat removal via the reactor containment fan coolers (RCFCs),
2. containment heat removal via the containment sumps [from containment spray] and reactor residual heat removal [via residual heat removal (RHR) system heat exchanger], and
3. engineered safety features (ESF) equipment heat loads (e.g., ESF equipment coolers and room coolers) and the Main Control Room chiller.

The licensee evaluated these sources with respect to the 106 °F peak post-accident temperature. In its evaluation, the licensee considered the impact of a 102.8 °F UHS temperature on the safety-related components being credited in the accident analyses.

The revised TS SR 3.7.9.2 allows a UHS temperature of less than or equal to 102.8 °F until September 30, 2021. This change allows operation with a higher UHS temperature of up to 102.8 °F during normal operation. The UHS requirements are based on the estimated analyzed

post-accident limit of 105.2 °F which provides 0.8 °F margin for the equipment temperature limit of 106 °F.

The U. S. Nuclear Regulatory Commission (NRC or Commission) staff notes that in the month of September, the average daily weather temperatures near the plant location will have a reduced likelihood of potential overtemperature condition and challenges to the TS temperature limit for the UHS. In its letter dated May 27, 2021, the licensee states that it is currently developing a license amendment request (LAR) for a long-term solution to address UHS temperature challenges. However, the LAR will not be completed in time to address potential UHS temperature impacts during summer 2021 operation. Therefore, the licensee requested this TS temperature change to cover a limited period of time.

3.1 Equipment Supported by SX

The licensee states in its LAR that the SX system supplies the safety-related loads and components required for safe shutdown. These include cubicle coolers, pump coolers, diesel engines coolers, containment coolers, CC water heat exchangers, RCFC and chiller condensers. The purpose of the UHS TS temperature limit is to restrict the initial UHS temperature such that the maximum UHS temperature (i.e., the temperature of the cooling water supplied to the plant safety systems from the UHS) experienced during the UHS design basis event would not exceed the design limit of the plant equipment cooled by the UHS. The post-accident performance of the equipment served by SX system has been analyzed for a SX supply temperature of 106 °F.

The licensee states in Section 3.0 of its LAR, that the current design basis analyses support an initial SX system temperature of less than or equal to 102 °F, as previously approved through license Amendment No. 189 and NRC safety evaluation (SE), “Braidwood Station Units 1 and 2 – Issuance of Amendments RE: Ultimate Heat Sink Temperature Increase,” dated July 26, 2016 (ADAMS Accession No. ML16133A438). In support of Amendment No. 189, the licensee used 106 °F to analyze the post-accident performance of the equipment served by SX, except for the RCFC which used 104 °F. The licensee in UFSAR, Section 9.2.1.2.1 (ADAMS Accession No. ML21008A403), states that the heat transfer equipment has been evaluated for the bounding temperature of 106 °F. The licensee’s UHS analysis of record, approved as part of the TS change to 102 °F, calculated the highest resulting UHS temperature following the design basis event would be less than or equal to 105.2 °F. The licensee in its LAR, provides a figure showing the temperature response for the worst-case LOCA. The licensee states in its LAR, “An evaluation has been completed that supports a 0.8 °F increase in SX temperature on accident analyses and containment response and analyses of the components served by SX.” The licensee concludes that an increase of 0.8 °F in allowable UHS TS temperature limit would result in a corresponding increase in the highest calculated design basis event UHS temperature to 106°F.

As documented in its July 26, 2016, SE, the NRC staff’s previous review included sensitivity runs performed at 102 °F. Additionally, the NRC staff performed sensitivity runs for a starting temperature greater than 102 °F and 75 percent heat transfer efficiency and found that peak return temperature exceeds 105.2 °F but did not exceed 106 °F for the evaluated runs. Since the runs used starting temperatures greater than 102 °F and the results did not exceed 106 °F, the NRC staff determined that the previous evaluation supports the acceptability of temperatures above 102 °F.

3.2 Impacts on Accident Analysis

3.2.1 Containment Integrity (UFSAR Chapter 6)

The licensee states in its LAR that the SX system supplies the RCFCs post-accident and that the temperature of the SX is an important factor in the heat removal capability of the RCFCs. The licensee's analysis done for containment integrity, as described in the UFSAR, Section 6.2.1.1.3 (ADAMS Accession No. ML19170A012), assumes an SX temperature of 104 °F. The figure on page 5 of the LAR shows the UHS temperature profile for the limiting design basis analysis. In this figure, it is seen that the starting temperature is 102 °F and does not reach 104 °F until a little after 36 hours later. Assuming the initial temperature is increased to 102.8 °F, as proposed in the LAR, the temperature response would be expected to follow the same trends as seen in the figure, only reach 104 °F a few hours earlier. During a LOCA or main steam line break (MSLB), the containment pressure and temperature would initially increase rapidly, then decrease over time as seen in UFSAR, Figures 6.2-1 through 6.2-15. The licensee in its LAR, states that the peak containment temperature and pressure occur early in the accident, well before the UHS post-accident temperature exceeds the RCFC analyzed temperature of 104 °F. The NRC staff notes that this justification was accepted by the NRC in its July 26, 2016, SE, for the initial temperature of 102 °F, and that this justification remains valid for the initial temperature being 102.8 °F because the UHS temperature exceeds the RCFC analyzed temperature after the RCFCs are needed to remove heat from the containment to reduce the peak temperature and pressure.

In addition, the licensee states in its LAR that the heat removal curve used for the RCFCs is conservative because it is based on a tube plugging level of 10 percent, while the actual tube plugging is less than 2 percent. Given that the containment pressures and temperatures have been significantly reduced from their respective calculated peak values by the time the UHS temperature exceeds the RCFC analyzed temperature of 104 °F, and the heat transfer of the RCFCs is conservatively modeled, NRC staff finds that the proposed increase in the UHS temperature will not result in exceeding any design criteria related to post-LOCA containment requirements.

3.2.2 Peak Clad Temperature Analyses

By letter dated December 28, 2020 (ADAMS Accession No. ML20317A001), the NRC staff issued an amendment for Braidwood to replace the LOCA methodologies with a single newer approved LOCA methodology, "the FULL SPECTRUM™[1] LOCA Evaluation Model (FSLOCA™ EM)." The licensee states in its May 27, 2021, LAR that the FSLOCA™ EM amendment has been implemented for Braidwood, Unit 1, and will be implemented for Braidwood, Unit 2, in the fall of 2021. The implementation for Unit 2 will take place in the fall 2021 outage which will occur after the September 30, 2021, expiration of the proposed temperature increase. Therefore, the following discussion for FSLOCA is applicable to Braidwood, Unit 1, and the large break LOCA and small break LOCA discussions are applicable to Braidwood, Unit 2.

[1] FULL SPECTRUM and FSLOCA are trademarks or registered trademarks of Westinghouse Electric Company LLC, its subsidiaries, and/or affiliates.

FSLOCA - Braidwood Station, Unit 1

Peak cladding temperature (PCT) is calculated for LOCAs in order to demonstrate compliance with the requirements of 10 CFR 50.46. During a LOCA, the emergency core cooling system (ECCS) water is initially drawn from the refueling water storage tank (RWST). When the RWST is nearly empty, the pumps are realigned to the containment sump (i.e., cold leg recirculation). The licensee states in its LAR that for the FSLOCA analyses, a conservative minimum switchover time of 1,038 seconds (about 17 minutes) was calculated using the minimum usable RWST volume, maximum containment spray flow, and a conservative total safety injection (SI) flow rate (injected plus spilled). For this initial calculation, it was conservatively assumed that the containment spray flow and SI flow begin at the start of the transient.

The FSLOCA analyses cover the full spectrum of break sizes. The break size spectrum is divided into two regions. Region I provides coverage of cold leg breaks with an inventory loss just exceeding the capability of the normal charging pumps to a maximum size corresponding to the inner diameter of the accumulator line. The Region II analysis simulations include breaks above 1.0 square foot break area, up to a maximum size of a double ended guillotine break. The licensee states in its LAR that for the Region II analysis, the time of PCT is less than 10 seconds and, therefore, is well within the switchover time of about 17 minutes, and the Region I analysis the time of PCT was 1,205 seconds (about 20 minutes). The licensee states in its LAR that for Region I breaks larger than approximately 4 inches in diameter, the PCT transient was over before the conservatively calculated switchover time. For Region I breaks smaller than approximately 4 inches, the licensee states in its LAR that calculations were performed to determine a more realistic containment spray actuation time based on the spray actuation setpoint in lieu of conservatively assuming containment spray starting at the beginning of the transient. These calculations showed that for a break size of 3.7 inches in diameter the switchover time was 1,778 seconds (about 30 minutes) and for smaller breaks the PCT transient was over before the realistic minimum switchover time.

During the long-term response to a large break LOCA, when the ECCS is drawing water from the containment sump, the UHS temperature can have an effect on cladding temperatures. However, as stated by the licensee, when switchover to the containment sump occurs, the PCTs are significantly lower, and a 0.8 °F variance in UHS temperature will not result in the clad temperatures challenging the calculated peak. Therefore, NRC staff finds that during the long-term response to a LOCA at Braidwood, Unit 1, the PCT will not be increased as a result of increasing the UHS temperature limit to 102.8 °F.

The SX system is the safety-related backup to the auxiliary feedwater (AFW) system. With the proposed increase to the UHS temperature limit, the AFW temperature could reach a maximum of 106 °F. The licensee states that the AFW is modeled in the FSLOCA analysis with a temperature of 113.5 °F. Therefore, NRC staff finds that the analysis temperature is bounding and the change to the UHS temperature would not impact the FSLOCA analysis due to an increase in AFW temperature.

Large Break and Small Break LOCA - Braidwood Station, Unit 2

The PCT is calculated for LOCAs in order to demonstrate compliance with the requirements of 10 CFR 50.46. During a LOCA, the ECCS water is initially drawn from the RWST. When the RWST is nearly empty, the pumps are realigned to the containment sump (i.e., cold leg recirculation). The licensee states in its LAR that assuming no single failure and full runout flow from all the pumps, the earliest time the RWST can empty is in excess of 10 minutes. Given

that the large break LOCA PCTs occur very early in the accident (96 seconds for Braidwood, Unit 2), and that the UHS temperature has no effect on the RWST water temperature, the NRC staff finds that the proposed increase of 0.8°F to the UHS temperature limit has no effect on the PCT for large break LOCAs while the ECCS is drawing water from the RWST.

During the long-term response to a large break LOCA, when the ECCS is drawing water from the containment sump, the UHS temperature can have an effect on cladding temperatures. However, as the licensee states in its LAR, at this point in the transient the PCTs are significantly lower, and a 0.8 °F variance in UHS temperature will not result in the clad temperatures challenging the calculated peak. Therefore, NRC staff finds that during the long-term response to the large break LOCA, the PCT will not be changed as a result of increasing the UHS temperature limit to 102.8 °F.

For the small break LOCA analysis, the licensee states that the UHS is not explicitly modeled, and, therefore, the proposed increase in UHS temperature does not directly impact the analysis. However, in its LAR, the licensee, identified other items which could affect the small break LOCA analysis as described below.

The SX system is the safety-related backup to the AFW system. With the proposed increase to the UHS temperature limit, the AFW temperature could reach a maximum of 106 °F. The licensee states that the AFW is modeled in the small break LOCA analysis with a temperature of 125 °F. Therefore, NRC staff finds that the analysis temperature is bounding and the change to the UHS temperature would not impact the small break LOCA analysis due to an increase in AFW temperature.

The licensee states that the temperature of the SI water in the small break LOCA analysis is assumed to be at 120 °F, based on the RWST as the source. As noted above for large break LOCA, the UHS temperature change does not impact the RWST. Therefore, NRC staff finds that the SI water temperature in the small break LOCA analysis is not impacted by the proposed increase to the UHS temperature limit.

The licensee states that the temperature of the recirculation water in the small break LOCA is set at 212 °F and that design analyses completed in support of the NRC's SE dated July 26, 2016, have calculated the RHR heat exchanger discharge temperature to be below 212 °F. The licensee also states that the CC heat exchanger has been evaluated and has been found to be able to remove the required heat load that supports the assumptions of the calculation with an SX supply temperature of 106 °F. Given that an initial UHS temperature of 102.8 °F results in a maximum UHS temperature of less than or equal to 106 °F, the NRC staff finds that the CC heat exchanger will remove the required amount of heat and the resulting temperature of the recirculation water will remain less than 212 °F. In summary, the NRC staff finds that the proposed 0.8 °F increase to the UHS temperature limit will have no detrimental impact on the small break LOCA analysis results.

The licensee also identified three non-LOCA events including MSLB, feedwater line break and steam generator tube rupture where ECCS is modeled and assumed to operate. The licensee states that these events are terminated well before the RWST is drained. Therefore, the NRC staff finds that the proposed 0.8 °F increase in UHS temperature limit will have no detrimental impact on these non-LOCA events.

3.2.3 Long Term Core Cooling and Hot Leg Switchover Analysis

The licensee states in its LAR, that the limiting UHS DBA that results in the maximum heat load on the UHS is one unit undergoing post-LOCA cooldown concurrent with a loss of off-site power (LOOP), in conjunction with the other unaffected unit undergoing a safe non-accident shutdown. During the long-term response to a LOCA, the operator is instructed by procedure to align the ECCS to cold leg recirculation when the RWST level reaches the auto switchover level setpoint and to hot leg recirculation at 6 hours, as stated in Section 15.0.14 of the UFSAR (ADAMS Accession No. ML21137A253). In Section 3.1 of its LAR, the licensee presented a figure showing the UHS temperature response following the worst-case LOCA that assumes a start time of 3 A.M. and an initial temperature of 102 °F. In this figure, it is seen that the temperature of the UHS decreases over 2 °F during the first 6 hours of the event. Using the licensee's figure and assuming a starting temperature of 102.8 °F, as proposed in the LAR, the NRC staff determined that the temperature at 6 hours would still be expected to be below that of the starting temperature. Given that this temperature is below the 106 °F analysis limit for performance of the equipment served by SX and the 104 °F analysis limit for the RCFC, the NRC staff finds that the existing design analysis for hot leg switchover remain acceptable with a maximum UHS starting temperature of 102.8 °F.

3.2.4 CC System to Reactor Coolant Pumps (RCPs)

The CC system adds heat to the UHS during normal plant operation and during accident conditions. The licensee states in Section 3.3.4 of its LAR:

> The maximum CC temperature to the Reactor Coolant Pumps (RCP) is 105 °F during normal plant operation. This temperature limit is raised to 120 °F for a short period (3 hours) when the Residual Heat Removal system is first used during RCS [reactor coolant system] cooldown. The postulated increase in CC temperature of 0.8 °F is found acceptable by Engineering Judgement. This is based on the small increase and the short duration considering the diurnal cycle of the UHS temperature profile.

In its SE dated July 26, 2016, the NRC staff concluded that the CC heat exchangers will satisfactorily function under DBA conditions with an SX temperature of 106 °F and will satisfactorily function under normal operating conditions with an SX temperature of 102 °F. The licensee provided engineering judgement to conclude the small increase and short duration at an elevated UHS temperature during normal operation is acceptable. Based on the above, the NRC staff agrees with the licensee's determination that the 0.8 °F increase of CC temperature is reasonable pertaining to the RCP function.

3.2.5 Other Analyses

In Section 3.3.5 of the LAR, the licensee also evaluated other considerations, such as the impact of increasing the UHS temperature to 102.8 °F on Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," and station blackout (SBO).

<u>GL 96-06:</u>

In reference to NRC GL 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions" (ADAMS Accession No. ML031110021), the licensee

identified a concern for possible water hammer following either a LOCA or a MSLB concurrent with a LOOP during the first few minutes post-accident while the pumps and fans are restarting following the LOOP. The licensee performed a detailed analysis to address the concern. The NRC staff previously concluded in its July 26, 2016, SE, that the licensee satisfactorily addressed the GL-96-06 issue for the proposed increase in the UHS temperature to less than or equal to 102°F.

In the LAR the proposed TS UHS temperature limit is 102.8 °F. The licensee states in Section 3.3.5 of its LAR that a slight increase in fluid temperature will not result in significant changes to the amount of voiding and thus negligible impacts to void collapse and the existing results of the previous analysis. Because the temperature increase is small, the NRC staff concludes that the 0.8 °F increase does not change the previous NRC staff finding pertaining to GL 96-06.

Diesel Driven AFW Pump Operation During Loss of All Alternating Current (AC) Power:

The licensee states in Section 3.3.5 of its LAR:

> In the event of a loss of all AC power (i.e., Station Blackout or SBO), a diesel driven SX booster pump operates to provide cooling water to the diesel driven AF [auxilary feed] pump and engine cooler. Due to the configuration of the discharge piping to the lake, there is insufficient booster pump head to maintain once-through flow to the lake during this event. Thus, flow recirculates through various components back to the diesel driven SX booster pump suction. This results in isolation of the cooling water heat sinks and heat-up of the isolated SX loop during the SBO coping period.
>
> Design analysis evaluates this transient and concludes that AF diesel engine jacket water temperature will not exceed the engine trip setpoint in 2 hours. The calculation evaluates a maximum UHS temperature of 102 °F. The analysis used a plugging level of 5 tubes for the 102 °F case. The analysis also determined that the allowed tube plugging decreases by two (2) tubes for each [one] °F increase in the SX temperature. The actual numbers of tubes that are plugged for the heat exchangers (1/2SX01K) is zero (0) for Unit 1 and one (1) for Unit 2. The actual plugging level supports a maximum SX temperature of 104 °F. Therefore, raising the SX temperature to 102.8 °F is acceptable.

Based on the actual tube plugging being significantly less than the assumption being used for the design analysis, the NRC staff finds the licensee's determination is acceptable.

3.2.6 Conclusion

Based on the above, the NRC staff concludes that raising the TS maximum UHS temperature to 102.8 °F until September 30, 2021, has no impact on the accident analysis.

3.3 Margin

In Section 4.2 of the LAR, the licensee states that there is no reduction in the margin of safety of the plant and that the proposed change continues to ensure that the maximum temperature of the cooling water supplied to the plant SSCs during a UHS design-basis event remains within the evaluated equipment limits and capabilities assumed in the accident analysis. However,

increasing the allowable temperature of the UHS to 102.8 °F reduces the margin between the UHS temperature and the analyzed equipment limits (106 °F). As discussed in the NRC staff's technical evaluation above, the licensee has identified additional current equipment margin and conservative assumptions included in the 106 °F analysis. Based on the above the NRC staff concludes that there is reasonable assurance that increasing the allowable temperature of the UHS to 102.8 °F will not result in equipment operating outside of its design.

The licensee states in its LAR that it is currently developing a LAR for a long term solution to address UHS temperature challenges. However, the LAR will not be completed in time to address potential UHS temperature impacts during summer 2021 operation. The possibility of approaching the existing temperature limit of 102 °F is significantly reduced beyond the month of September. As a result, the licensee requested the TS change applicability to expire after September 30, 2021.

3.4 Technical Conclusion

Based on the above, the NRC staff finds that increasing the TS UHS temperature limit to 102.8 °F has no impact on the accident analysis. The NRC staff also finds that increasing the TS UHS temperature limit to 102.8 °F does not significantly affect the equipment that is cooled by the UHS. The NRC staff also finds that increasing the TS UHS temperature limit to 102.8 °F has no effect on the structure of the UHS nor the amount of water available to the UHS. The NRC staff, therefore, concludes that the licensee continues to meet the requirements of GDC 44.

Based on the technical acceptability of the SR 3.7.9.2 change as discussed in Section 3 of this SE, the NRC staff finds that the revised SR 3.7.9.2 assures that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the LCOs will be met. The NRC staff, therefore, concludes that 10 CFR 50.36(c)(3) is met.

Based on the above, the NRC staff concludes that the SR changes listed in Section 2.2 of this SE are acceptable.

4.0 FINAL NO SIGNIFICANT HAZARDS CONSIDERATION

The NRC staff proposed no significant hazards consideration was published in the *Federal Register* on June 10, 2021 (86 FR 30991).

The NRC's regulation in 10 CFR 50.92(c) states that the NRC may make a final determination, under the procedures in 10 CFR 50.91, that a license amendment involves no significant hazards consideration if operation of the facility, in accordance with the amendment, would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

An evaluation of the issue of no significant hazards consideration provided by the licensee is presented below:

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

   Response: No.

   The likelihood of a malfunction of any systems, structures, or components (SSCs) supported by the Ultimate Heat Sink (UHS) is not significantly increased by increasing the allowable UHS temperature from ≤ 102°F to ≤ 102.8°F. The UHS provides a heat sink for process and operating heat from safety related components during a transient or accident, as well as during normal operation. The proposed change does not make any physical changes to any plant SSCs, nor does it alter any of the assumptions or conditions upon which the UHS is designed. The UHS is not an initiator of any analyzed accident. All equipment supported by the UHS has been evaluated to demonstrate that their performance and operation remains as described in the UFSAR with no increase in probability of failure or malfunction.

   The SSCs credited to mitigate the consequences of postulated design basis accidents remain capable of performing their design basis function. The change in maximum UHS temperature has been evaluated using the UFSAR described methods to demonstrate that the UHS remains capable of removing normal operating and post-accident heat. The change in UHS temperature and resulting containment response following a postulated design basis accident has been demonstrated to not be impacted. Additionally, all the UHS supported equipment, credited in the accident analysis to mitigate an accident, has been shown to continue to perform their design function as described in the UFSAR.

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

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

   Response: No.

   The proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated. The proposed change does not introduce any new modes of plant operation, change the design function of any SSC, or change the mode of operation of any SSC. There are no new equipment failure modes or malfunctions created as affected SSCs continue to operate in the same manner as previously evaluated and have been evaluated to perform as designed at the increased UHS temperature and as assumed in the accident analysis. Additionally, accident initiators remain as described in the UFSAR and no

new accident initiators are postulated as a result of the increase in UHS temperature.

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

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

Response: No.

The proposed change continues to ensure that the maximum temperature of the cooling water supplied to the plant SSCs during a UHS design basis event remains within the evaluated equipment limits and capabilities assumed in the accident analysis. The proposed change does not result in any changes to plant equipment function, including setpoints and actuations. All equipment will function as designed in the plant safety analysis without any physical modifications. The proposed change does not alter a limiting condition for operation, limiting safety system setting, or safety limit specified in the Technical Specifications.

The proposed change does not adversely impact the UHS inventory required to be available for the UFSAR described design basis accident involving the worst case 30-day period including losses for evaporation and seepage to support safe shutdown and cooldown of both Braidwood Station units. Additionally, the structural integrity of the UHS is not impacted and remains acceptable following the change, thereby ensuring that the assumptions for both UHS temperature and inventory remain valid.

Therefore, since there is no adverse impact of this proposed change on the Braidwood Station safety analysis, there is no reduction in the margin of safety of the plant.

The NRC staff reviewed the licensee's no significant hazards consideration analysis. Based on the review and on the NRC staff evaluation of the underlying LAR as discussed above, the staff concludes that the three standards of 10 CFR 50.92(c) are satisfied. Therefore, the NRC staff has made a final determination that no significant hazards consideration is involved for the proposed amendments and that the amendments should be issued as allowed by the criteria contained in 10 CFR 50.91.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Illinois State official was notified of the proposed issuance of the amendment on June 10, 2021. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The NRC staff published an Environmental Assessment (EA) in the *Federal Register* on July 7, 2021 (86 FR 35831) related to this proposed action. In that EA, the NRC staff concluded that the proposed action would not have a significant effect on the quality of the human environment.

Accordingly, the NRC staff determined that an environmental impact statement was not warranted for the proposed action.

7.0 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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

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Date of issuance: July 13, 2021

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2, - ISSUANCE OF AMENDMENTS NOS. 222 AND 222 RE: REVISION OF TECHNICAL SPECIFICATIONS FOR THE ULTIMATE HEAT SINK (EPID L-2021-LLA-0095) DATED JULY 13, 2021

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