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

September 10, 2024

David P. Rhoades
Senior Vice President
Constellation Energy Generation, LLC
President and Chief Nuclear Officer
Constellation Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 - ISSUANCE OF AMENDMENT NOS. 235 AND 235 RE: REVISION OF TECHNICAL SPECIFICATIONS FOR THE ULTIMATE HEAT SINK (EPID L-2024-LLA-0075)

Dear David Rhoades:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 235 to Renewed Facility Operating License No. NPF-72 and Amendment No. 235 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 June 4, 2024 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML24156A245).

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, 2024.

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. 235 to NPF-72
2. Amendment No. 235 to NPF-77
3. Safety Evaluation

cc: Listserv

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

CONSTELLATION ENERGY GENERATION, LLC

DOCKET NO. STN 50-456

BRAIDWOOD STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 235
Renewed License No. NPF-72

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Constellation Energy Generation, LLC (the licensee) dated June 4, 2024, 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. 235 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 14 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

BRENT BALLARD

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Jeffrey A. Whited, 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: September 10, 2024

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

CONSTELLATION ENERGY GENERATION, LLC

DOCKET NO. STN 50-457

BRAIDWOOD STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 235
Renewed License No. NPF-77

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Constellation Energy Generation, LLC (the licensee) dated June 4, 2024, 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. 235 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 14 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

BRENT BALLARD

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Jeffrey A. Whited, 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: September 10, 2024

ATTACHMENT TO LICENSE AMENDMENT NOS. 235 AND 235

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) Constellation Energy Generation, 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) Constellation Energy Generation, 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) Constellation Energy Generation, 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) Constellation Energy Generation, 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. 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. 235 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) Constellation Energy Generation, 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) Constellation Energy Generation, 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) Constellation Energy Generation, 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) Constellation Energy Generation, 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. 235 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, 2024. After September 30, 2024, 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. 235 TO RENEWED FACILITY OPERATING

LICENSE NO. NPF-72 AND AMENDMENT NO. 235 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-77

CONSTELLATION ENERGY GENERATION, LLC

BRAIDWOOD STATION, UNITS 1 AND 2

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

1.0 INTRODUCTION

By letter dated June 4, 2024 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML24156A245) Constellation Energy Generation, LLC, (the licensee), submitted a license amendment request (LAR) for changes to Technical Specification (TS) 3.7.9, “Ultimate Heat Sink (UHS)” for Braidwood Station, Units 1 and 2 (Braidwood). 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, 2024. The proposed action is nearly identical to previously approved license amendments that allowed for the average water temperature of the UHS to be ≤ 102.8°F until September 30, 2020, September 30, 2021, September 30, 2022, and September 30, 2023. The NRC issued the license amendments on September 24, 2020 (ML20245E419), July 13, 2021 (ML21154A046), August 10, 2022 (ML22173A214), and July 13, 2023 (ML23087A076), respectively. The NRC staff’s evaluation of the current LAR is presented below.

2.0 REGULATORY EVALUATION

2.1 System Description

The UHS consists of an essential service cooling pond (ESCP) integral with the main cooling pond. In Section 2.4.11.6 of the Updated Final Safety Analysis Report (UFSAR), Revision 19, dated December 16, 2022 (Accession No. ML24103A226), the licensee 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. In Section 2.4.1.1 of the UFSAR, the licensee states 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 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 (WX) pumps and circulating water (CW) pumps also take suction from the UHS during normal operation. Operation of the WX and CW pumps for post-accident conditions is not analyzed in the UFSAR since the units 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 amendment request until September 30, 2024.

Original SR 3.7.9.2:

> Verify average water temperature of UHS is ≤ 102.8 °F until September 30, 2023. After September 30, 2023, 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, 2024. After September 30, 2024, 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 section 3.1.1 (ML24103A228) of the Braidwood UFSAR, the licensee concludes that Braidwood fully satisfies and is in compliance with General Design Criteria (GDC) 44, “Cooling Water.” GDC 44 is relevant to the change requested by the licensee’s June 4, 2024, 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 technical specification (TS) 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

Section IV, “Acceptance Criteria” and “Evaluation Findings” of section 9.2.5, “Ultimate Heat Sink,” Revision 2, July 1981 (ML052350549) of NUREG-0800 “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [light-water reactor] Edition,” 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 and 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 SFP 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. The current UHS analysis of record was approved as part of the TS change to 102°F based on the highest resulting UHS temperature following the design basis event. If the requirement for temperature of the SX system supplied by the UHS exceeds the TS limit, 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 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.

The licensee states, in its letter dated June 4, 2024, that the limiting design basis analysis includes three sources of heat energy to be transferred by the SX system after a LOCA:

1. containment heat removal via the RCFCs,
2. containment heat removal via the containment sumps [from containment spray] and reactor residual heat removal [via 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 and the 104°F temperature used for the RCFCs. In its evaluation, the licensee considered the

impact of a 102.8°F starting UHS temperature on the safety-related components being credited in the accident analyses.

The licensee considered eight temperature profile cases with start times staggered by 3 hours starting with 00:00 (Midnight). The analysis covers the 30-day period after a LOCA with starting temperature of 102°F. The licensee found that the 03:00 (3 a.m.) case is limiting with respect to the calculated peak post-accident temperature (see figure on page 5 of the LAR) while the 09:00 (9 a.m.) case, because of diurnal effects, exceeds 104°F shortly after 4 hours into the event until approximately 10 hours. The maximum calculated temperature for this period is 104.2°F at approximately 6 to 9 hours into the event with an initial UHS temperature of 102.8°F. (see figure on page 6 of the LAR).

The revised TS SR 3.7.9.2 allows a UHS temperature of less than or equal to 102.8°F until September 30, 2024. 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.

3.1 Equipment Supported by SX

The licensee states in its LAR that the 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 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 (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 states, in section 9.2.1.2.1 (ML22355A546) of the UFSAR 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 provides a figure showing the temperature response for the worst-case LOCA in its LAR. 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 (ML24103A229), assumes an SX temperature of 104°F. The figure on page 5 of the LAR shows the UHS temperature profile for the limiting case with respect to the calculated peak post-accident UHS temperature. The figure shows the temperature response for this worst-case LOCA at a start time of 3 a.m. In this figure, 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. The licensee provides an additional figure on page 6 of the LAR showing the UHS temperature profile at a start time of 9 a.m. and beginning with 102.8°F temperature. The UHS exceeds 104°F after 4 hours into the event until approximately 10 hours into the event with maximum calculated temperature of 104.2°F. The licensee states that the post-accident containment pressures and temperatures have been significantly reduced from the calculated peak value at 4 hours after the event and this excursion above 104°F by 0.2°F does not affect the results of the LOCA and main steam line break (MSLB) containment integrity analyses. The licensee indicates that for both units the containment pressure is below 16 psig (pounds per square inch gauge), the containment temperature is below 201°F, and the sump water temperature is below 190°F. The licensee in its LAR states that the peak containment temperature and pressure occur early in the accident, which is before the UHS post-accident temperature exceeds the RCFC analyzed temperature of 104°F. During a LOCA or 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, which confirms the peak containment temperature occurs prior to the UHS exceeding 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.

The licensee also 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 a maximum of 3 percent for one of the RCFCs. Given that the containment pressures and temperatures have been 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 significant design criteria related to post-LOCA containment requirements.

3.2.2 Peak Clad Temperature Analyses

By letter dated December 28, 2020 (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)." This change has been implemented for both units.

FSLOCA - Braidwood Station, Unit 1 and Unit 2

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. For the Region II analysis, the table on page 10 of Attachment 1 to the licensee's June 4, 2024, letter, shows the maximum time of PCT is 35 seconds for Braidwood, Unit 2. This is well within the switchover time of about 17 minutes. For the Region I analysis the maximum time of PCT is for Braidwood, Unit 1 at 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

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

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.

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 (ML24103A232). 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, 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

The licensee also evaluated other considerations in section 3.3.5 of the LAR, 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).

GL 96-06:

In reference to NRC GL 96-06, “Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions” (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.

The proposed TS UHS temperature limit is 102.8°F in the LAR. 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. The NRC staff concludes that the 0.8°F increase does not change the previous NRC staff finding pertaining to GL 96-06 because the temperature increase is small.

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 [auxiliary 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 two (2) for Unit 2. The actual plugging level supports a maximum SX temperature of 103.5 °F. Therefore, raising the SX temperature to 102.8 °F is acceptable.

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

3.3 Margin

The licensee states, in section 4.3 of the LAR, 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.

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, does not significantly affect the equipment that is cooled by the UHS, and 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 STATE CONSULTATION

In accordance with the Commission's regulations, the Illinois State official was notified of the proposed issuance of the amendment on June 11, 2024. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The NRC staff published an Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) in the *Federal Register* on July 31, 2024 (89 FR 61500), 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 and has prepared a FONSI.

6.0 CONCLUSION

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

Principal Contributor: J. Wiebe, NRR

Date of issuance: September 10, 2024

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 - ISSUANCE OF AMENDMENT NOS. 235 AND 235 RE: REVISION OF TECHNICAL SPECIFICATIONS FOR THE ULTIMATE HEAT SINK (EPID L-2024-LLA-0075) DATED SEPTEMBER 10, 2024

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