



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

August 5, 2015

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

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3, AND QUAD CITIES
NUCLEAR POWER STATION, UNITS 1 AND 2 - ISSUANCE OF
AMENDMENTS CONCERNING ADDING TOPICAL REFERENCES TO
TECHNICAL SPECIFICATIONS (TAC NOS. MF3359, MF3360, MF3361, AND
MF3362) (RS-13-288)

Dear Mr. Hanson:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 247 to Renewed Facility Operating License No. DPR-19 and Amendment No. 240 to Renewed Facility Operating License No. DPR-25 for Dresden Nuclear Power Station, Units 2 and 3 (DNPS), and Amendment No. 260 to Renewed Facility Operating License No. DPR-29 and Amendment No. 255 to Renewed Facility Operating License No. DPR-30 for Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS), respectively. The amendments are in response to your application dated December 19, 2013 as supplemented by a letter dated June 29, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML13354C045 and ML15180A166, respectively).

The amendments add an NRC-approved topical report reference to the list of analytical methods in the Technical Specifications (TSs) that are used to determine the core operating limits and allows DNPS and QCNPS to use the most current methodology in the determination of the average planar linear heat generation rate (APLHGR) limits contained in TS 3.2.1. Specifically, the addition of this methodology supports operation of the SVEA-96 Optima2 fuel and determining the core operating limits for future core configurations, by crediting steam cooling for a longer time than previous models, which results in a reduction in the maximum peak clad temperature.

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

Sincerely,

/RA/

Eva A. Brown, Senior Project Manager
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-237, 50-249, 50-254, and 50-265

Enclosures:

1. Amendment No. 247 to DPR-19
2. Amendment No. 240 to DPR-25
3. Amendment No. 260 to DPR-29
4. Amendment No. 255 to DPR-30
5. Safety Evaluation

cc w/encls: Distribution via Listserv



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

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-237

DRESDEN NUCLEAR POWER STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 247
Renewed License No. DPR-19

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by the Exelon Generation Company, LLC (the licensee) dated December 19, 2013 as supplemented by letter dated June 29, 2015, 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 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. DPR-19 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 247, are hereby incorporated into the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Benjamin G. Beasley, Acting Branch Chief
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: August 5, 2015



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

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-249

DRESDEN NUCLEAR POWER STATION, UNIT 3

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 240
Renewed License No. DPR-25

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by the Exelon Generation Company, LLC (the licensee) dated December 19, 2013 as supplemented by letter dated June 29, 2015, 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 license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 3.B. of Renewed Facility Operating License No. DPR-25 is hereby amended to read as follows:

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 240, are hereby incorporated into the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Benjamin G. Beasley, Acting Branch Chief
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: August 5, 2015

ATTACHMENT TO
LICENSE AMENDMENT NOS. 247 AND 240
RENEWED FACILITY OPERATING LICENSE NOS. DPR-19 AND DPR-25
DOCKET NOS. 50-237 AND 50-249

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

Remove

License DPR-19
Page 3

License DPR-25
Page 4

TSs
5.6-4

Insert

License DPR-19
Page 3

License DPR-25
Page 4

TSs
5.6-4

- (2) Exelon Generation Company, LLC, pursuant to the Act and 10 CFR Part 70, to receive, possess and use at any time special nuclear materials as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Updated 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 special nuclear materials as may be produced by the operation of the facility.

C. This renewed operating 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; 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 steady state reactor core power levels not in excess of 2957 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. 247, are hereby incorporated into this renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

(3) Operation in the coastdown mode is permitted to 40% power.

- f. Surveillance Requirement 4.9.A.10 - Diesel Storage Tank Cleaning
(Unit 3 and Unit 2/3 only)

Each of the above Surveillance Requirements shall be successfully demonstrated prior to entering into MODE 2 on the first plant startup following the fourteenth refueling outage (D3R14).

3. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations: 10 CFR Part 20, Section 30.34 of 10 CFR Part 30, Section 40.41 of 10 CFR Part 40, Sections 50.54 and 50.59 of 10 CFR Part 50, and Section 70.32 of 10 CFR Part 70; 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:

A. Maximum Power Level

The licensee is authorized to operate the facility at steady state power levels not in excess of 2957 megawatts (thermal), except that the licensee shall not operate the facility at power levels in excess of five (5) megawatts (thermal), until satisfactory completion of modifications and final testing of the station output transformer, the auto-depressurization interlock, and the feedwater system, as described in the licensee's telegrams; dated February 26, 1971, have been verified in writing by the Commission.

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 240, are hereby incorporated into this renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

C. Reports

The licensee shall make certain reports in accordance with the requirements of the Technical Specifications.

D. Records

The licensee shall keep facility operating records in accordance with the requirements of the Technical Specifications.

E. Restrictions

Operation in the coastdown mode is permitted to 40% power.

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

9. WCAP-15942-P-A, "Fuel Assembly Mechanical Design Methodology for Boiling Water Reactors, Supplement 1 to CENPD-287."
10. CENPD-390-P-A, "The Advanced PHOENIX and POLCA Codes for Nuclear Design of Boiling Water Reactors."
11. WCAP-16865-P-A, "Westinghouse BWR ECCS Evaluation Model Updates: Supplement 4 to Code Description, Qualification and Application," Revision 1, October 2011.

The COLR will contain the complete identification for each of the TS referenced topical reports used to prepare the COLR (i.e., report number, title, revision, date, and any supplements).

- c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.
- d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

5.6.6 Post Accident Monitoring (PAM) Instrumentation Report

When a report is required by Condition B or F of LCO 3.3.3.1, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.



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

EXELON GENERATION COMPANY, LLC

AND

MIDAMERICAN ENERGY COMPANY

DOCKET NO. 50-254

QUAD CITIES NUCLEAR POWER STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 260
Renewed License No. DPR-29

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Exelon Generation Company, LLC, et al. (the licensee) dated December 19, 2013 as supplemented by letter dated June 29, 2015, 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 license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 3.B. of Renewed Facility Operating License No. DPR-29 is hereby amended to read as follows:

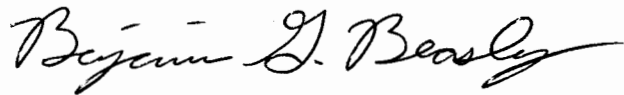
Enclosure 3

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 260 are hereby incorporated into the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Benjamin G. Beasley, Acting Branch Chief
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: August 5, 2015



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

EXELON GENERATION COMPANY, LLC

AND

MIDAMERICAN ENERGY COMPANY

DOCKET NO. 50-265

QUAD CITIES NUCLEAR POWER STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 255
Renewed License No. DPR-30

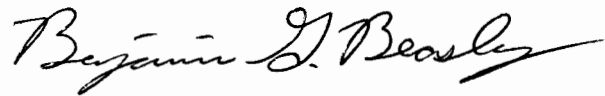
1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Exelon Generation Company, LLC, et al. (the licensee) dated December 19, 2013 as supplemented by letter dated June 29, 2015, complies with the standards and requirements of the Atomic Energy 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 license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 3.B. of Renewed Facility Operating License No. DPR-30 is hereby amended to read as follows:

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 255 , are hereby incorporated into the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Benjamin G. Beasley, Acting Branch Chief
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: August 5, 2015

ATTACHMENT TO
LICENSE AMENDMENT NOS. 260 AND 255
RENEWED FACILITY OPERATING LICENSES NOS. DPR-29 AND DPR-30
DOCKET NOS. 50-254 AND 50-265

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

Remove

License DPR-29
Page 4

License DPR-30
Page 4

TSs
5.6-4

Insert

License DPR-29
Page 4

License DPR-30
Page 4

TSs
5.6-4

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 260, are hereby incorporated into this renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

C. The licensee shall maintain the commitments made in response to the March 14, 1983, NUREG-0737 Order, subject to the following provision:

The licensee may make changes to commitments made in response to the March 14, 1983, NUREG-0737 Order without prior approval of the Commission as long as the change would be permitted without NRC approval, pursuant to the requirements of 10 CFR 50.59. Consistent with this regulation, if the change results in an Unreviewed Safety Question, a license amendment shall be submitted to the NRC staff for review and approval prior to implementation of the change.

D. Equalizer Valve Restriction

Three of the four valves in the equalizer piping between the recirculation loops shall be closed at all times during reactor operation with one bypass valve open to allow for thermal expansion of water.

E. The licensee shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822), and the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined sets of plans¹, which contain Safeguards Information protected under 10 CFR 73.21, is entitled: Quad Cities Nuclear Power Station Security Plan, Training and Qualification Plan, and Safeguards Contingency Plan, Revision 2, submitted by letter dated May 17, 2006.

F. The licensee shall implement and maintain in effect all provisions of the approved fire protection program as described in the Updated Final Safety Analysis Report for the facility and as approved in the Safety Evaluation Reports dated July 27, 1979 with supplements dated November 5, 1980, and

¹ The Training and Qualification Plan and Safeguards Contingency Plan are Appendices to the Security Plan.

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 255, are hereby incorporated into this renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

C. The license shall maintain the commitments made in response to the March 14, 1983, NUREG-0737 Order, subject to the following provision:

The licensee may make changes to commitments made in response to the March 14, 1983, NUREG-0737 Order without prior approval of the Commission as long as the change would be permitted without NRC approval, pursuant to the requirements of 10 CFR 50.59. Consistent with this regulation, if the change results in an Unreviewed Safety Question, a license amendment shall be submitted to the NRC staff for review and approval prior to implementation of the change.

D. Equalizer Valve Restriction

Three of the four valves in the equalizer piping between the recirculation loops shall be closed at all times during reactor operation with one bypass valve open to allow for thermal expansion of water.

E. The licensee shall fully implement and maintain in effect all provisions of the Commission-approved physical security, training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822), and the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans¹, which contain Safeguards Information protected under 10 CFR 73.21, is entitled: Quad Cities Nuclear Power Station Security Plan, Training and Qualification Plan, and Safeguards Contingency Plan, Revision 2, submitted by letter dated May 17, 2006.

F. The licensee shall implement and maintain in effect all provisions of the approved fire protection program as described in the Updated Final Safety Analysis Report for the facility and as approved in the Safety Evaluation Reports dated July 27, 1979 with supplements dated

¹ The Training and Qualification Plan and Safeguards Contingency Plan are Appendices to the Security Plan.

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

8. WCAP-15836-P-A, "Fuel Rod Design Methods for Boiling Water Reactors - Supplement 1."
9. WCAP-15942-P-A, "Fuel Assembly Mechanical Design Methodology for Boiling Water Reactors Supplement 1 to CENPD-287."
10. CENPD-390-P-A, "The Advanced PHOENIX and POLCA Codes for Nuclear Design of Boiling Water Reactors."
11. WCAP-16865-P-A, "Westinghouse BWR ECCS Evaluation Model Updates: Supplement 4 to Code Description, Qualification and Application," Revision 1, October 2011.

The COLR will contain the complete identification for each of the TS referenced topical reports used to prepare the COLR (i.e., report number, title, revision, date, and any supplements).

- c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.
- d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

5.6.6 Post Accident Monitoring (PAM) Instrumentation Report

When a report is required by Condition B or F of LCO 3.3.3.1, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 247 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-19,

AMENDMENT NO. 240 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-25,

AMENDMENT NO. 260 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-29

AND

AMENDMENT NO. 255 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-30

EXELON GENERATION COMPANY, LLC

MIDAMERICAN ENERGY COMPANY

DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3, AND

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-237, 50-249, 50-254 AND 50-265

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC, the Commission) dated December 19, 2013 (the submittal), as supplemented by a letter dated June 29, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML13354C045 and ML15180A166, respectively), Exelon Generation Company, LLC, et al. (the licensee) requested changes to the technical specifications (TSs) for Dresden Nuclear Power Station, Units 2 and 3 (DNPS), and Quad Cities Nuclear Power Station, Units 1 and 2 (QCNPS). The proposed changes would add an NRC-approved topical report reference to the list of analytical methods in the TSs that are used to determine the core operating limits and allows DNPS and QCNPS to use the most current methodology in the determination of the average planar linear heat generation rate (APLHGR) limits contained in TS 3.2.1.

The June 29, 2015 supplement, contained clarifying information and did not change the NRC staff's initial proposed finding of no significant hazards consideration dated July 8, 2014 (79 FR 38577).

2.0 REGULATORY EVALUATION

2.1 Background

The design basis accident for a boiling water reactor (BWR) is a double ended guillotine break of the largest pipe in the primary system, which is a recirculation pipe. Following this accident, the reactor coolant system (RCS) will lose most of its coolant inventory before any emergency core cooling system (ECCS) cooling flow is available. Once ECCS flow is available, the reactor will slowly refill terminating the temperature rise in the core. Computer codes, such as Westinghouse's GOBLIN CHACHA, are used to calculate the heat being transferred from the fuel to the coolant during such an accident. GOBLIN calculates the system transient response to a loss-of-coolant accident (LOCA) and other figures of merit that are used as boundary conditions in the heat-up calculation where the results are compared to regulatory limits to ensure the safety of the public if such an unlikely event were to occur.

This model is described in WCAP-16865-NP-A, which was originally approved by the NRC staff in 1989. In Supplement 4 to this topical report (TR), Westinghouse proposed to change how the end of lower plenum flashing is determined, by crediting lower plenum flashing for a longer time in the current evaluation model. The additional crediting of lower plenum flashing would provide increased steam cooling to the fuel and reduce the peak clad temperature (PCT). The NRC-approved the supplement in a safety evaluation dated September 29, 2011 (ADAMS Accession No. ML11308A064).

2.2 Regulatory Requirements

Section 50.46 to Title 10 to the *Code of Federal Regulations* (10 CFR), requires that the ECCS be designed so that its cooling performance is in accordance with an acceptable evaluation model, which identifies and accounts for uncertainties in the analysis method and inputs; alternatively, an ECCS evaluation model may be developed in conformance with Appendix K to 10 CFR Part 50 (Appendix K).

Appendix K describes the required and acceptable features of the ECCS evaluation models. Of particular relevance to this is Paragraph I.D.6 of Appendix K that specifies acceptable convective heat transfer coefficients (HTCs) for BWR fuel rods under spray cooling depending upon three post-blowdown phenomena. These phenomena are as follows:

- During the period following lower plenum flashing but prior to the core spray reaching rated flow;
- During the period after core spray reaches rated flow but prior to reflooding; and,
- After the two-phase reflooding fluid reaches the level under consideration.

General Design Criteria (GDC) 35 specified in Appendix A to 10 CFR Part 50 requires a system to provide abundant emergency core cooling to transfer heat from the reactor core following any loss of reactor coolant at a rate such that:

- Fuel and clad damage that could interfere with continued effective core cooling is prevented; and,
- Clad metal-water reaction is limited to negligible amounts.

Section 4.2 of NUREG-800 Standard Review Plan (SRP) provides guidance to meet 10 CFR 50.46. This fuel system safety review provides assurance that:

- The calculated maximum fuel element cladding temperature shall not exceed 2200 degrees F (10 CFR 50.46(b)(1));
- The calculated total oxidation of the cladding shall nowhere exceed 0.17 times the total cladding thickness before oxidation (10 CFR 50.46(b)(2));
- The calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 0.01 times the hypothetical amount that would be generated if all of the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react (10 CFR 50.46(b)(3));
- Calculated changes in core geometry shall be such that the core remains amenable to cooling (10 CFR 50.46(b)(4)); and,
- After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core (10 CFR 50.46(b)(5)).

Section 6.3 to the SRP provides guidance related to the design of ECCS to determine whether it is capable of performing all of the functions required by the design bases. Calculated changes in core geometry are reviewed to ensure that the core remains amenable to cooling; and after any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core.

Section 15.6.5 to the SRP presents review guidelines for LOCA analyses for BWRs to support the evaluation of the ability of the ECCS to mitigate the consequences of a spectrum of LOCAs.

Section 5.6.3 of NUREG-1433, "Standard Technical Specifications - General Electric Plants, BWR/4," Rev. 4 provides guidance for the content and format of the TS associated with the Core Operating Limits Report (COLR). This section includes format expectations for TR references as provided in a letter dated August 4, 2011 (ADAMS Accession No. ML110660285). Additionally from that letter, the NRC staff has indicated that licensees must obtain NRC approval prior to editing the reference list of methodologies in the TSs. One reason that NRC approval is required prior to editing the reference list is so that the NRC staff can review the methodology and ensure that it is applicable to the facility of a given licensee. Additionally, the NRC staff can verify that the licensee has properly satisfied all implementation conditions and limitations associated with a given methodology. Because there is no inherent requirement to ensure that the implementation conditions and limitations associated with methodology revisions are maintained the same as previous revisions to the same methodology, or that the applicability of subsequent methodology revisions remains the same as earlier methodologies, the NRC staff has found that affording licensees the administrative flexibility to transition between or among methodology revisions is inappropriate.

3.0 TECHNICAL EVALUATION

As a technical basis for the proposed TS change, Exelon included the ECCS analysis for QCNPS, Units 1 and 2, using the NRC-approved new methodology in WCAP-16865-NP-A for determining the end of lower plenum flashing for analysis of a LOCA.

The NRC staff performed a technical review of Attachment 4 to the December 19, 2013, submittal (Westinghouse TR) to determine whether the analysis presented meets the applicable requirements in 10 CFR 50.46 and Appendix K. The NRC staff's technical evaluation consisted of the following steps:

- Verification of the application of the new methodology to ECCS performance of both QCNPS and DNPS;
- Evaluation of the results of ECCS performance after LOCAs in QCNPS and DNPS; and,
- Evaluation of the technical bases for the TS changes.

3.1 Application of the Methodology

In the process of reviewing the Westinghouse TR, the NRC staff also asked the licensee to demonstrate that the Quad Cities and Dresden plants are sufficiently "similar." The licensee was also asked to confirm that the application of the methodology applied for QCNPS will be applied for DNPS 'similarly' when applied in the future. In the June 29, 2015 supplement, the licensee explained that due to identical geometry, identical initial conditions, and similar ECCS performance, the limiting break size, break location, and single failure shown for QCNPS will be the same for the DNPS units. The licensee indicated that the LPCI-IV failure will continue to be the limiting failure. The NRC staff found that the information provided by the licensee confirms that the new methodology can also be applied to ECCS performance of the DNPS because of the similarity between QCNPS and DNPS.

3.2 ECCS LOCA Performance

During a LOCA, before any ECCS flow starts to inject into the core, but after the liquid water in the core has become steam, the only means for convective cooling of the core is the steam generated in the lower plenum due to flashing. As the RCS pressure decreases, the saturation pressure and consequently the saturation temperature of the water in the lower plenum decreases. The water temperature will be above the saturation temperature, and therefore some of the water flashes to steam. The steam generated can be quite substantial and thus the cooling provided by the steam can dramatically reduce the fuel temperatures. Therefore it is important to ensure that this phenomenon is conservatively modeled.

The NRC staff reviewed the Westinghouse TR and, in general, it was found that the system response and the ECCS performance appear consistent with the NRC-approved ECCS evaluation model in WCAP-16865-NP-A. A review of Figure B-40 of the Westinghouse TR shows the HTCs calculated using GOBLIN and used by CHACHA (part of GOBLIN) for the limiting large break accident. Results of the CHACHA simulation show that the CHACHA code uses the HTC predicted by GOBLIN until the core spray reaches the rated flow at 45.7 seconds. It was noted that a HTC of 17 W/m²- degrees Celsius (degrees C) is used from 45.7 seconds to around 180 seconds, which indicated to the NRC staff that the two-phase reflooding fluid would

reach the level under consideration at 180 seconds. An HTC of $142 \text{ W/m}^2\text{-degrees C}$ is used after 180 seconds. The NRC observed that HTCs selected by the licensee were consistent with Paragraph I.D.6(b) of Appendix K. As shown in Table B-7 of the Westinghouse TR, the low plenum flashing starts at 6.3 seconds and ends at 57.8 seconds. Therefore, the NRC finds the HTC predicted by GOBLIN was appropriately applied to the fuel rods through the rated core spray flow, which was reached at 45.7 seconds.

The NRC staff reviewed the system performance discussions given in Sections A.4.2 through A.4.5 of the Westinghouse TR, concerning the operation of each system of the ECCS (HPCI, LPCI, LPCS, and ADS). On page 34 of the Westinghouse TR, the NRC was concerned that the equation given implies that the pressure loss (or differential pressures) along the leakage flow path is the same as the pressure loss for the LPCS or LPCI flow. The NRC staff questioned the upstream and downstream locations of the two pressure losses and the basis for the assumption that the two pressure losses are the same. In the Attachment to the supplement dated June 29, 2015, the licensee provided the specific locations between which the pressure losses occur. The licensee's explained that the questioned equation was developed based on the assumption that the pressure drop across the spray nozzle and across the leakage locations are approximately the same. The NRC staff found the use of this assumption is acceptable.

The NRC staff questioned why the (recirculation pump) coast down time constant of 4.45 seconds is conservative compared to the typical time of > 5.1 seconds. The licensee explained in the June 29, 2015 supplement, that a faster coast down time causes a more rapid decrease in core flow with less cooling after reactor trip, resulting in an earlier transition from nuclear boiling. This response is acceptable.

In Section B.4.1 of the Westinghouse TR, the licensee summarized the PCT results of a break spectrum analysis in Table B-2 that considered four possible single failures for a recirculation line break. Tables B-3 through B-6 provided the PCT results of each of those cases separately. The NRC staff reviewed these tables and noticed inconsistencies with the break spectrum PCT summary in Table B-2 when compared to the more detailed data provided for each single failure provided in Tables B-3 through B-6. In the June 29, 2015 supplement, the licensee indicated that the PCT values given in Tables B-3 through B-6 were not correct and provided updated tables with the correct PCTs.

Section B.4.4 of the Westinghouse TR addresses the failure of the high pressure coolant injection (HPCI) system, while Section B.4.5 addresses the failure of the LPCI loop selection logic (LSL). As discussed in the submittal, Figures B-26 and B-33 provide a graphical representation of the results for a limiting break size of 0.10 ft^2 and 1.0 ft^2 respectively. The NRC staff reviewed these figures and noticed inconsistencies in the graphical representation of the flow rates. The licensee reviewed the figures and provided revised figures in the June 29, 2015 supplement that represents the proper location, timing, and flow rate for the affected cases.

The NRC staff in its review assessed the proper implementation of the approved methodology, applicability of the provided QNPS analysis to DNPS, and the use of the HTCs. The NRC staff found that the licensee had properly modeled the various ECCS systems, break sizes, and events. As indicated in Section B.5 of the Westinghouse TR, Figure B-41 shows the results of calculated PCT values over the course of the limiting large break accident. The NRC staff

verified that the calculated maximum cladding temperature for the limiting large break accident was below the 10 CFR 50.46 limit of 2200 degrees F.

The NRC staff verified the licensee provided information to demonstrate that the Westinghouse TR approval limitation as described in the method to determine the end of lower plenum flashing was properly applied. A review of the information provided in the Westinghouse TR demonstrated that the licensee had properly applied the identified limitation.

3.3 Proposed TS Changes

The licensee proposes to revise TS Section 5.6.5, "Core Operating Limits Report," to add an NRC-approved TR reference to the list of analytical methods that are used to determine the core operating limits. Specifically, the proposed change adds the NRC-approved WCAP-16865-P-A, Rev. 1. As indicated in the August 4, 2011 letter, the NRC specifically requested licensees to include the revision number and dates for the TR reference being added to TS 5.6.5. The review of the applicability of this TR reference to QCNPS and DNPS was provided above.

As discussed above, the NRC staff has confirmed that the new methodology is applicable to QCNPS and DNPS, and the results of ECCS performance after LOCAs complies with the 10 CFR 50.46 and Appendix K regulatory basis and associated acceptance criteria. Therefore, the NRC staff concludes that the addition of the Westinghouse TR to the QCNPS and DNPS TS 5.6.5 is acceptable.

3.4 Technical Conclusion

The NRC Staff has reviewed the Westinghouse TR submitted by the licensee in support of revising TS Section 5.6.5. Based on the evaluation, the NRC staff concludes that the information provided satisfies the limitation and condition delineated in the NRC-approved TR of the new methodology. Results of the QCNPS ECCS analysis, using the new methodology of determining the end of lower plenum flashing for analysis of a LOCA, were found to comply with the regulatory requirements, guidance, and acceptance criteria. Furthermore, the technical review concludes that the QCNPS analysis is also applicable to DNPS. In conclusion, the NRC staff evaluation finds the proposed TS changes acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Illinois State official was notified of the proposed issuance of the amendments. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change the requirements with respect to the installation or use of a facility's components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding

(79 FR 38577; July 8, 2014). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

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

7.0 REFERENCES

1. Gullott, David M., "Request for License Amendment to Technical Specifications Section 5.6.5., Core Operating Limits Report," Exelon Generation Company, LLC, December 19, 2013.
2. Westinghouse Electric Company, LLC, "Quad Cities 1 & 2 LOCA Analysis for SVEA-96 Optima2 Fuel," NF-BEX-13-143-P, Rev. 2, November 2013.
3. Westinghouse Electric Company, "Westinghouse BWR ECCS Evaluation Model Updates: Supplement 4 to Code Description. Qualification and Application," WCAP-16865-P-A, Rev.1, Westinghouse Electric Company, LLC, October 2011.
4. Exelon letter, "Additional Information Regarding Request for License Amendment to Revise Technical Specifications Section 5.6.5, "Core Operating Limits Report," RS-15-182, dated June 29, 2015.
5. Gullott, D. M. (Exelon Generation Company, LLC) to NRC, "License Amendment Request to Technical Specifications Section 5.6.5, 'Core Operating Limits Report,'" dated April 3 ,2012
6. Email from B. Mozafari (NRC) to J. A. Bauer (Exelon Generation Company, LLC), "Need to supplement application dated April 3, 2012 (RS-12-036)," dated May 8, 2012 (ADAMS Accession No. ML 12130A339).
7. NRC, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," NUREG-0800, Rev. 3, March 2007.
8. NRC letter to Exelon Generation Company, LLC. "Dresden Nuclear Power Station, Units 2 and 3 and Quad Cities Nuclear Power Station, Units 1 and 2 – Request for Additional Information Related to License Amendment Request. Technical Specification Changes, to Add an NRC Approved TR Reference (MF3359 to 3362)," February 5, 2015.

9. Ebeling-Koning, D. B., M. E. Nissley, J. T. Dederer, A. F. Gagnon, and J. M. Brennar, "Westinghouse Boiling Water Reactor Emergency Core Cooling System Evaluation Model: Code Description and Qualification," Westinghouse Electric Corporation, WCAP-11284-P-A, October 30, 1989.

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Date of issuance: August 5, 2015

- 2 -

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

Sincerely,

/RA/

Eva A. Brown, Senior Project Manager
Plant Licensing III-2 and
Planning and Analysis Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-237, 50-249, 50-254, and 50-265

Enclosures:

1. Amendment No. 247 to DPR-19
2. Amendment No. 240 to DPR-25
3. Amendment No. 260 to DPR-29
4. Amendment No. 255 to DPR-30
5. Safety Evaluation

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