



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

December 4, 2019

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 TO REVISE TECHNICAL SPECIFICATION 2.1.1, "REACTOR  
CORE SAFETY LIMITS," REGARDING THE MINIMUM CRITICAL POWER  
RATIO SAFETY LIMITS (EPID L-2018-LLA-0499)**

Dear Mr. Hanson:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment Nos. 263 and 256 to Renewed Facility Operating License Nos. DPR-19 and DPR-25 for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Amendment Nos. 276 and 271 to Renewed Facility Operating License Nos. DPR-29 and DPR-30 for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The amendments consist of changes to the technical specifications (TSs) in response to your license amendment request dated December 5, 2018.

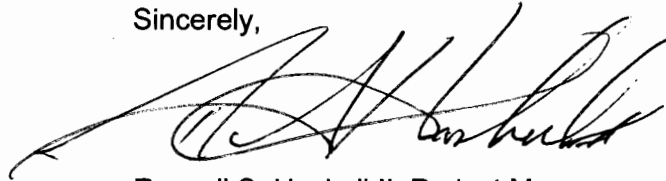
The amendments revise TS 2.1.1, "Reactor Core SLs [Safety Limits]," regarding the Minimum Critical Power Ratio Safety Limits (SLMCPR) for both single recirculation loop and two-recirculation loop operations, to provide for improved operational flexibility through the recapture of margins that are available because of the transition to the Framatome, Inc. NRC-approved SLMCPR calculation methodology. The proposed changes are not required for any of the current operating cycles. The current and anticipated future core designs that utilize ATRIUM 10XM fuel for DNPS and QCNPS allow for these changes.

B. Hanson

-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,

A handwritten signature in black ink, appearing to read "R. S. Haskell II", written in a cursive style.

Russell S. Haskell II, Project Manager  
Plant Licensing Branch III  
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. 263 to DPR-19
2. Amendment No. 256 to DPR-25
3. Amendment No. 276 to DPR-29
4. Amendment No. 271 to DPR-30
5. Safety Evaluation

cc w/encls: 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. 263  
Renewed License No. DPR-19

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 December 5, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, 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. 263, are hereby incorporated into this renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

Enclosure 1

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

A handwritten signature in black ink, reading "Nancy L. Salgado". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

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: December 4, 2019



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. 256  
Renewed License No. DPR-25

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 December 5, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, 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. 256, are hereby incorporated into this 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 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

A handwritten signature in black ink, appearing to read "Nancy L. Salgado".

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: December 4, 2019

ATTACHMENT TO LICENSE AMENDMENT NOS. 263 AND 256

DRESDEN NUCLEAR POWER STATION, UNITS 2 and 3

DOCKET NOS. 50-237 AND 50-249

RENEWED FACILITY OPERATING LICENSE NOS. DPR-19 AND DPR-25

Replace the following page(s) of Renewed Facility Operating License No. DPR-19 and DPR-25 with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Remove

Insert

Page 3 (DPR-19)

Page 3 (DPR-19)

Page 4 (DPR-25)

Page 4 (DPR-25)

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contain marginal lines indicating the areas of change.

TS

TS

Page 2.0-1

Page 2.0-1

- (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. 263, 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. 256, 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.

## 2.0 SAFETY LIMITS (SLs)

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### 2.1 SLs

#### 2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 685 psig or core flow < 10% rated core flow:

THERMAL POWER shall be  $\leq$  25% RTP.

2.1.1.2 With the reactor steam dome pressure  $\geq$  685 psig and core flow  $\geq$  10% rated core flow:

For two recirculation loop operation, MCPR shall be  $\geq$  1.08, or for single recirculation loop operation, MCPR shall be  $\geq$  1.10.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

#### 2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be  $\leq$  1345 psig.

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### 2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

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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. 276  
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 (the licensee) dated December 5, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, 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:
  - B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 276, are hereby incorporated into this 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 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



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: December 4, 2019



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. 271  
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 (the licensee) dated December 5, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, 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. 271, are hereby incorporated into this 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 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



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: December 4, 2019

ATTACHMENT TO LICENSE AMENDMENT NOS. 276 AND 271

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 and 2

DOCKET NOS. 50-254 AND 50-265

RENEWED FACILITY OPERATING LICENSE NOS. DPR-29 AND DPR-30

Replace the following page(s) of Renewed Facility Operating License No. DPR-29 and DPR-30 with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Remove

Insert

Page 4 (DPR-29)

Page 4 (DPR-29)

Page 4 (DPR-30)

Page 4 (DPR-30)

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contain marginal lines indicating the areas of change.

TS

TS

Page 2.0-1

Page 2.0-1

B. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 276, 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 plans,<sup>1</sup> 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.

Exelon Generation Company shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The Exelon Generation Company CSP was approved by License Amendment No. 249 as modified by License Amendment No. 259.

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

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<sup>1</sup> 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. 271, 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.

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Exelon Generation Company shall fully implement and maintain in effect all provisions of the Commission-approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The Exelon Generation Company CSP was approved by License Amendment No. 244 and modified by License Amendment No. 254.

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

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<sup>1</sup> The Training and Qualification Plan and Safeguards Contingency Plan are Appendices to the Security Plan.

## 2.0 SAFETY LIMITS (SLs)

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### 2.1 SLs

#### 2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 685 psig or core flow < 10% rated core flow:

THERMAL POWER shall be  $\leq$  25% RTP.

2.1.1.2 With the reactor steam dome pressure  $\geq$  685 psig and core flow  $\geq$  10% rated core flow:

For two recirculation loop operation, MCPR shall be  $\geq$  1.08, or for single recirculation loop operation, MCPR shall be  $\geq$  1.10.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

#### 2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be  $\leq$  1345 psig.

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### 2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 263 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-19

AMENDMENT NO. 256 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-25

AMENDMENT NO. 276 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-29

AMENDMENT NO. 271 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-30

EXELON GENERATION COMPANY, LLC

DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3

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 dated December 5, 2018 (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML18339A009), Exelon Generation Company, LLC, (EGC, the licensee) acting for itself and MidAmerican Energy Company, requested changes to modify Technical Specifications (TS) 2.1.1, "Reactor Core SLs [Safety Limits]," for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. Specifically, these changes incorporate revised minimum critical power ratio safety limits (SLMCPRs) in accordance with analyses performed by Framatome, Inc. for DNPS and QCNPS, Cycles 26 and 25, respectively.

The U.S. Nuclear Regulatory Commission (NRC or Commission) staff finds that the licensee's proposed amendments to update the TSs to include cycle-specific SLMCPR numeric values is based on NRC-approved methodologies that have been approved for use with Framatome, Inc. fuel. The proposed changes would revise TS 2.1.1 DNPS, Units 2 and 3, and QCNPS, Units 1 and 2. Specifically, the proposed changes incorporate revised SLMCPRs (TS 2.1.1.2) due to the current cycle specific analyses performed by Framatome, Inc. for DNPS, Units 2 and 3, Cycles 26, and QCNPS, Units 1 and 2, Cycles 25, respectively. Analyses performed in support of the proposed changes utilized cycle-specific input to establish the appropriate SLMCPRs.

The purpose of proposed changes is to provide improved operational flexibility through the recapture of margins that are available as a result of the transition to Framatome, Inc. NRC approved SLMCPR calculation methodology.

## 2.0 REGULATORY EVALUATION

### 2.1 System Description

Fuel design limits can be exceeded if the fuel produces heat equal to or greater than critical power. In a boiling-water reactor (BWR), heat produced by the fuel causes the water to partially vaporize in a stable process called nucleate boiling. As the amount of heat produced by the fuel increases, more of the water vaporizes and the vapor production changes the way the water boils. At a certain point, the efficiency of heat removal is impeded by vapor production and the temperature of the fuel cladding rises disproportionately to the heat generated. Critical power is a term used for the power at which the annular film on the fuel dries out. For BWRs, the critical power may be predicted using a correlation of experimental data. The ATRIUM™ 10 XM critical power correlation is used for the ATRIUM™ 10 XM fuel. The SPCB [Siemens Power Corporation B] critical power correlation is used for the OPTIMA2 fuel. DNPS, Units 2 and 3, and QCNPS, Units 1 and 2, currently operate with mixed core fuel loadings consisting of ATRIUM™ 10 XM and OPTIMA2 fuel types. Due to core-wide and operational variations, the margin to boiling transition is most easily described in terms of a critical power ratio (CPR), which is defined as the rod critical power as calculated by the correlation divided by the actual rod power. The more a CPR value exceeds 1.0, the greater margin to boiling transition.

To protect against boiling transition, BWRs have established MCPR safety limits in their TSs. The current SLMCPRs at Exelon's facilities are based on preventing 99.9 percent of the fuel in the core from being susceptible to boiling transition. Such limits are typically developed by considering various cycle-specific power distributions and uncertainties, and they are highly dependent on the cycle-specific radial power distribution in the core. As such, the MCPR safety limits may need to be updated as frequently as every cycle.

The TSs for both DNPS and QCNPS include MCPR operating limits as limiting conditions for operation (LCOs), which must be met to ensure that anticipated operational occurrences do not result in fuel damage. Currently, the MCPR operating limits are calculated by combining the largest change in CPR from all analyzed transients with the MCPR safety limit.

### 2.2 Licensee's Proposed TS Changes

The DNPS, Units 2 and 3, are BWR Type 3 reactors that have two recirculation loops. The proposed amendment reflects a decrease of the two-recirculation loop (TLO) SLMCPR from greater than or equal to ( $\geq$ ) 1.12 to  $\geq$  1.08 and a decrease in the single recirculation loop (SLO) SLMCPR from  $\geq$  1.14 to  $\geq$  1.10.

The QCNPS, Unit 1, is a BWR Type 3 reactor that has two recirculation loops. The proposed amendment reflects a decrease of the TLO SLMCPR from  $\geq$  1.11 to  $\geq$  1.08 and a decrease in the SLO SLMCPR from  $\geq$  1.14 to  $\geq$  1.10.

The QCNPS, Unit 2, is a BWR Type 3 reactor that has two recirculation loops. The proposed amendment reflects a decrease of the TLO SLMCPR from  $\geq$  1.12 to  $\geq$  1.08 and a decrease in the SLO SLMCPR from  $\geq$  1.14 to  $\geq$  1.10.

## 2.3 Applicable Regulatory Requirements, Design, and Guidance Documents

The regulatory requirements and guidance documents that the NRC staff considered in its review of the proposed amendments included the following:

### 2.3.1 Regulatory Requirements

The regulation at Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.36(a)(1), requires an applicant for an operating license to include in the application proposed TSs in accordance with the requirements of 10 CFR 50.36. The applicant must also include in the application a "summary statement of the bases or reasons for such specifications, other than those covering administrative controls." However, per 10 CFR 50.36(a)(1), these TS bases "shall not become part of the technical specifications."

As required by 10 CFR 50.36(c), TSs will include, among other things:

- (1) *Safety limits, limiting safety system settings, and limiting control settings.*
  - (i)(A) Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity. If any safety limit is exceeded, the reactor must be shut down. The licensee shall notify the Commission, review the matter, and record the results of the review, including the cause of the condition and the basis for corrective action taken to preclude recurrence. Operation must not be resumed until authorized by the Commission.

### 2.3.2 Regulatory Design Requirements

Appendix A, "General Design Criteria (GDC) for Nuclear Power Plants," to 10 CFR Part 50 establishes the minimum requirements for the principal design criteria for water-cooled nuclear power plants. The GDC were originally published in the *Federal Register* (36 FR 12733) on February 20, 1971, and became effective on May 21, 1971. GDC 10, "Reactor design," states:

The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

GDC 10 is not applicable to DNPS and QCNPS since the construction permits for DNPS, Units 2 and 3 (1966), and QCNPS, Units 1 and 2 (1967), were issued prior to May 21, 1971. However, both DNPS and QCNPS have final design criteria that, within the scope of this application, are equivalent to GDC 10. This can be determined by referencing the associated updated final safety analysis report (UFSAR) for each site.<sup>1</sup> The limits placed on the MCPR are specified acceptable fuel design limits to prevent boiling transition used to meet GDC 10, or its equivalent.

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<sup>1</sup> Refer to DNPS UFSAR (v13) Section 3.1.2, "Compliance with Final Design Criteria," (Criterion 10) (ADAMS Accession No. ML19177A191).  
Refer to QCNPS UFSAR (v15) Section 3.1.2, "Group II – Protection by Multiple Fission Product Barriers," (Criterion 6) (ADAMS Accession No. ML19298C378).

### 2.3.3 Regulatory Guidance

Guidance on the acceptability of the reactivity control systems, the reactor core, and fuel system design is provided in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP). Specifically, SRP Section 4.2, Revision 2, "Fuel System Design" (Reference 1), specifies all fuel damage criteria for evaluation of whether fuel designs meet the specified acceptable fuel design limits (SAFDLs). SRP, Section 4.4, "Thermal and Hydraulic Design" (Reference 2), provides guidance on the review of thermal-hydraulic design in meeting the requirement of GDC 10 and the fuel design criteria established in SRP, Section 4.2. It states that the critical power ratio (CPR) is to be established such that at least 99.9 percent of fuel rods in the core would not be expected to experience departure from nucleate boiling or boiling transition during normal operation or anticipated operational occurrences.

## 3.0 TECHNICAL EVALUATION

Section 2.2 above lists the proposed changes to TS 2.1.1.2 for DNPS and QCNPS. The following sections summarize the NRC staff's evaluation of each of these proposed changes.

### 3.1 Staff Evaluation of Proposed TS Changes for SLMCPR

The SLMCPR for DNPS and QCNPS is established such that at least 99.9 percent of the fuel rods in the core would not be expected to experience the onset of transition boiling as a result of normal operation and transients, which in turn ensures fuel cladding damage does not occur. The SLMCPR limit is established such that fuel design limits are not exceeded during steady state operation, normal operational transients, and abnormal operational transients. As such, fuel damage is calculated not to occur if the limit is not exceeded. Fuel damage is not directly observable, a step-back approach is used to establish corresponding operating limits. The operating limit minimum critical power ratio (OLMCPR) is established by summing the cycle-specific core reload transient analyses adders and the calculated SLMCPR values. The OLMCPR is required to be established and documented in the core operating limits report (COLR) for each reload cycle by DNPS and QCNPS TSs, Section 5.6.5, "Core Operating Limits Report (COLR)."

The absolute value of SLMCPR tends to vary cycle to cycle, typically due to the introduction of improved fuel bundle types, changes in fuel vendors or applicable computer codes, and changes in core loading pattern. Following the determination of the cycle-specific SLMCPR values, the OLMCPR values are derived. The cycle-specific SLMCPR numeric values are listed in DNPS and QCNPS TSs, Section 2.1.1, and, therefore, must be revised using the license amendment process.

The NRC staff concludes that the SLMCPR will continue to provide assurance that 99.9 percent of the fuel rods in the core will not exceed the CPR (not susceptible to boiling transition) and that fuel cladding integrity will be maintained under conditions of normal operation and with appropriate margin for anticipated operational occurrences.

The NRC staff verified that the proposed changes would continue to meet the applicable regulations and requirements (SE Section 2.3) and that the analysis performed to calculate the DNPS, Units 2 and 3, and the QCNPS, Units 1 and 2, SLMCPR numeric values were based upon NRC-approved methodologies.

### 3.2 Staff Evaluation of Licensee Methodologies

The DNPS and QCNPS SLMCPR calculations were performed by Framatome, Inc., and the results were provided in proprietary Attachments 9, 10, 11, and 12, of the license amendment request (LAR). The calculations used NRC-approved methodologies and uncertainties, as documented in the following topical reports (TRs):

1. ANP-10307NPA, Revision 0, "AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," AREVA NP, June 2011 (Reference 3);
2. ANP-10298PA, Revision 1, "ACE/ATRIUM 10XM Critical Power Correlation," AREVA NP, March 2014<sup>2</sup> (Reference 4);
3. BAW-10247PA, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," AREVA NP, February 2008<sup>3</sup> (Reference 5);
4. EMF-2158(P)(A), Revision 0, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-41 MICROBURN-B2," Siemens Power Corporation, October 1999<sup>4</sup> (Reference 6); and
5. ANP-3338P Revision 1, Applicability of AREVA BWR Methods to Dresden and Quad Cities Reactor Operating at Extended Power Uprate, AREVA, August 2015 (Reference 8);

These methodologies were used for the DNPS, Units 2 and 3, Cycles 26, and QCNPS, Units 1 and 2, Cycles 25, SLMCPR calculations. The NRC staff reviewed the Framatome, Inc. calculations to ensure that the generic methods were appropriately applied to DNPS and QCNPS. The DNPS, Units 2 and 3, Cycles 26, and QCNPS, Units 1 and 2, Cycles 25, cores are made up of OPTIMA2 and ATRIUM™ 10XM fuels. No plant hardware or operational changes are required with this proposed change.

By letter dated June 14, 2011 (Reference 7), the NRC staff provided its final safety evaluation (SE) regarding plant-specific application of the NRC-approved SAFLIM3D methodology described in ANP-10307NPA, Revision 0. The SE identified a concern related to the channel bow model. To address this concern, Framatome, Inc. corrected the computed fluence gradient in DNPS and QCNPS SLMCPR calculations contained in Attachments 9, 10, 11, and 12, of this LAR. The NRC staff reviewed the information provided in the analysis sections of the LAR and concludes that the licensee's use of plant-specific fluence gradient values in calculating channel bow for DNPS and QCNPS resolve the staff concern related to channel bow and is acceptable.

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<sup>2</sup> NRC Letter, Sher Bahadur (NRC) to Pedro Salas (AREVA Inc.) "Final Safety Evaluation by the Office of Nuclear Reactor Regulation for Topical Report ANP-10298PA, Revision 0, Supplement 1P, Revision 0, 'Improved K-Factor Model for ACE/ATRIUM 10XM Critical Power Correlation'," (TAC NO. ME7963), March 31, 2014.

<sup>3</sup> NRC Letter, Ho K. Nieh (NRC) to Ronnie L. Gardner (AREVA NP Inc.), "Final Safety Evaluation for AREVA NP Inc. (AREVA) Topical Report (TR) BAW-10247(P), Revision 0, 'Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors,' (TAC No. MC4261)."

<sup>4</sup> NRC Letter, Stephen Dembek (NRC) to James F. Mallay (SPC), "Acceptance for Referencing of Licensing Topical Report EMF-2158(P), Revision 0, Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2 (TAC NO. MA4592)," October 18, 1999.

The ATRIUM™ 10XM critical power correlation (Reference 4) is used for the ATRIUM™ 10XM fuel while the SPCB critical power correlation (Reference 6) is used for the OPTIMA2 fuel. The SPCB and ATRIUM™ 10XM critical power correlations limits of applicability for local peaking factor is provided as an NRC safety evaluation report (SER) limitation when the correlations were approved. Fuel that is resident in DNPS, Units 2 and 3, Cycles 26 and QCNPS, Units 1 and 2, Cycles 25 cores, were designed to be below the acceptable limit and address the staff concern.

Therefore, based on the information provided by the licensee, the NRC staff finds that the licensee has demonstrated that this SER restriction is satisfied. Based on the analysis performed by Framatome, Inc. using the NRC-approved methodologies described above, the licensee has proposed to amend the DNPS, Units 2 and 3, and QCNPS, Units 1 and 2, TSs, Section 2.1.1.2, to revise the SLMCPR. The plant-specific SLMCPR analyses were performed for DNPS and QCNPS at the rated power.

The current required SLMCPR values in DNPS, Units 2 and 3, TSs are  $\geq 1.12$  for TLO and  $\geq 1.14$  for SLO. Calculations performed by Framatome, Inc. for DNPS, Units 2 and 3, resulted in a minimum calculated value of SLMCPR to be  $\geq 1.08$  for TLO, and  $\geq 1.10$  for SLO, for both units.

The current required SLMCPR values in QCNPS TSs are  $\geq 1.11$  (Unit 1) and  $\geq 1.12$  (Unit 2) for TLO and  $\geq 1.14$  (Units 1 and 2) for SLO. Calculations performed by Framatome, Inc. for QCNPS, Units 1 and 2, resulted in a minimum calculated value of SLMCPR to be  $\geq 1.08$  for TLO, and  $\geq 1.10$  for SLO, for both Units.

The NRC staff did not identify any departures from NRC-approved methodologies or deviations from NRC-approved calculational uncertainties in the DNPS and QCNPS SLMCPR calculations. Framatome, Inc. calculations of the revised plant-specific SLMCPR numeric values for DNPS and QCNPS were performed as part of the reload licensing analysis for DNPS and QCNPS and are based upon NRC-approved methods and, therefore, the NRC staff has determined this to be acceptable.

### 3.3 NRC Staff's Technical Summary

The NRC staff has determined that the licensee's proposed amendments to update the TSs to include cycle-specific SLMCPR numeric values are based on NRC-approved methodologies that have been approved for use with Framatome, Inc. fuel and that the staff's SER restrictions were appropriately satisfied, without any departures or deviations. The amendments are consistent with the regulatory requirements and guidance as discussed in Section 2.3 of this SE and, therefore, are acceptable. Specifically, the fuel cladding is one of the physical barriers that separate the radioactive materials from the environment. The SLMCPR is an SL that is required to be in TSs to ensure that fuel design limits are not exceeded. The SLMCPR limit is contained in DNPS and QCNPS TS, Section 2.1.1.2, and it can vary from cycle to cycle. Since the licensee's proposed TS changes are consistent with the requirements of 10 CFR 50.36(c), the NRC staff concludes these TS changes are acceptable. Defense-in-depth and sufficient safety margins will continue to be maintained.

The NRC staff concludes that the licensee's proposed SLMCPRs are acceptable fuel design limits and that the proposed TS changes are consistent with DNPS and QCNPS design bases to meet the intent of GDC 10, "Reactor design," of Appendix A to 10 CFR Part 50, which states



that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that SAFDLs are not exceeded.

Therefore, based on the above considerations, the NRC staff concludes that the licensee's TS changes, as proposed in this application, 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 November 22, 2019. The State official had no comments.

#### 5.0 ENVIRONMENTAL CONSIDERATION

The amendments change the requirements with respect to installation or use of a facility's components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration on April 9, 2019 (84 FR 14147); there has been no public comment on such finding. 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. SRP Section 4.2, Revision 2, "Fuel System Design" (NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition") (ADAMS Accession No. ML070740002).
2. SRP Section 4.4, "Thermal and Hydraulic Design" (NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition") (ADAMS Accession No. ML070550060).
3. ANP-10307NPA, Revision 0, "AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," AREVA NP, June 2011 (ADAMS Accession No. ML11259A021).
4. ANP-10298PA, Revision 1, "ACE/ATRIUM 10XM Critical Power Correlation," AREVA NP, March 2014 (ADAMS Accession No. ML14183A734).

5. BAW-10247PA, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," AREVA NP, February 2008 (ADAMS Accession No. ML081340208).
6. EMF-2158(P)(A), Revision 0, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASM0-4 I MICROBURN-B2," Siemens Power Corporation, October 1999 (ADAMS Accession No. ML003698495).
7. Letter from Robert Nelson, NRC, to Pedro Salas, AREVA NP Inc., "Final Safety Evaluation for AREVA NP, Inc. Topical Report ANP-10307P, Revision 0, "AREVA MCPR [Minimum Critical Power Ratio] Safety Limit Methodology for Boiling Water Reactors," dated June 14, 2011 (ADAMS Accession No. ML11140A125).
8. ANP-3338P Revision 1, Applicability of AREVA BWR Methods to Dresden and Quad Cities Reactor Operating at Extended Power Uprate, AREVA, August 2015 (ADAMS Accession No. ML15251A383).

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