



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

July 19, 2016

Mr. Regis T. Repko
Senior Vice President
Governance, Projects and Engineering
Duke Energy
P.O. Box 1006 / EC07H
Charlotte, NC 28202

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2; MCGUIRE NUCLEAR STATION, UNITS 1 AND 2; AND OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 – ISSUANCE OF AMENDMENTS REGARDING REQUEST TO USE AN ALTERNATE FISSION GAS GAP RELEASE FRACTION (CAC NOS. MF6480, MF6481, MF6482, MF6483, MF6484, MF6485, AND MF6486)

Dear Mr. Repko:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 285 to Renewed Facility Operating License (RFOL) No. NPF-35 and Amendment No. 281 to RFOL No. NPF-52 for the Catawba Nuclear Station, Units 1 and 2; Amendment No. 289 to RFOL No. NPF-9 and Amendment No. 268 to RFOL No. NPF-17 for the McGuire Nuclear Station, Units 1 and 2; and Amendment No. 401, to RFOL No. DPR-38, Amendment No. 403 to RFOL No. DPR-47, and Amendment No. 402 to RFOL No. DPR-55 for the Oconee Nuclear Station Units 1, 2 and 3, respectively.

The amendments are being issued in response to your application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The amendments involve changes to the facilities' Updated Final Safety Analysis Reports and approve the use of a new set of fission gas gap release fractions for high burnup fuel rods that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," July 2000.

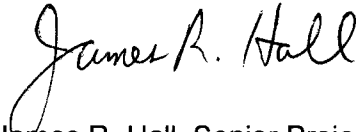
A copy of the related Safety Evaluation is also enclosed. A Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

R. Repko

- 2 -

If you have any questions, please contact me by phone at 301-415-4032 or by e-mail at Randy.Hall@nrc.gov.

Sincerely,



James R. Hall, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413, 50-414, 50-369,
50-370, 50-269, 50-270,
and 50-287

Enclosures:

1. Amendment No. 285 to NPF-35
2. Amendment No. 281 to NPF-52
3. Amendment No. 289 to NPF-9
4. Amendment No. 268 to NPF-17
5. Amendment No. 401 to DPR-38
6. Amendment No. 403 to DPR-47
7. Amendment No. 402 to DPR-55
8. Safety Evaluation

cc w/enclosures: Distribution via Listserv



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-413

CATAWBA NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 285
Renewed License No. NPF-35

1. The Nuclear Regulatory Commission (the Commission, NRC) has found that:
 - A. The application for amendment to the Catawba Nuclear Station, Unit 1 (the facility), Renewed Facility Operating License No. NPF-35, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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.

Enclosure 1

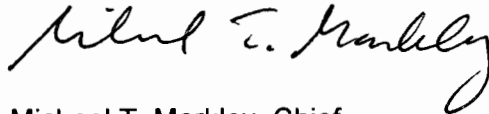
2. Accordingly, by Amendment No. 285, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas gap release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-414

CATAWBA NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 281
Renewed License No. NPF-52

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to the Catawba Nuclear Station, Unit 2 (the facility), Renewed Facility Operating License No. NPF-52, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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.

Enclosure 2

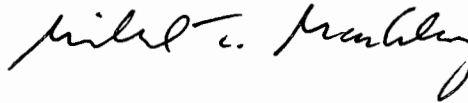
2. Accordingly, by Amendment No. 281, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas gap release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



UNITED STATES
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WASHINGTON, D.C. 20555-0001

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-369

MCGUIRE NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 289
Renewed License No. NPF-9

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to the McGuire Nuclear Station, Unit 1 (the facility), Renewed Facility Operating License No. NPF-9, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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, by Amendment No. 289, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas gap release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-370

MCGUIRE NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 268
Renewed License No. NPF-17

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to the McGuire Nuclear Station, Unit 2 (the facility), Renewed Facility Operating License No. NPF-17, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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.

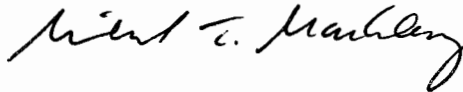
2. Accordingly, by Amendment No. 268, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas gap release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-269

OCONEE NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 401
Renewed License No. DPR-38

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to the Oconee Nuclear Station, Unit 1 (the facility), Renewed Facility Operating License No. DPR-38, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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.

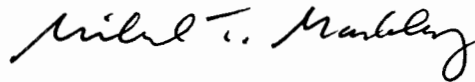
2. Accordingly, by Amendment No. 401, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-270

OCONEE NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 403
Renewed License No. DPR-47

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to the Oconee Nuclear Station, Unit 2 (the facility), Renewed Facility Operating License No. DPR-47, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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.

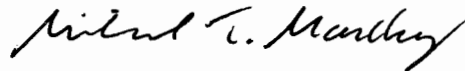
2. Accordingly, by Amendment No. 403, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas gap release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



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

DUKE ENERGY CAROLINAS, LLC

DOCKET NO. 50-287

OCONEE NUCLEAR STATION, UNIT 3

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 402
Renewed License No. DPR-55

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment to the Oconee Nuclear Station, Unit 3 (the facility), Renewed Facility Operating License No. DPR-55, filed by Duke Energy Carolinas, LLC (the licensee), dated July 15, 2015, as supplemented by letter dated February 1, 2016, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;
 - 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.

Enclosure 7

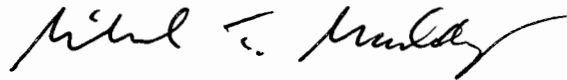
2. Accordingly, by Amendment No. 402, the license is amended to authorize revision to the Updated Final Safety Analysis Report (UFSAR), as set forth in the application dated July 15, 2015, as supplemented by letter dated February 1, 2016. The licensee shall update the UFSAR to incorporate the new set of fission gas gap release fractions for high-burnup fuel pins that exceed the linear heat generation rate limit detailed in Table 3, Footnote 11 of Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," as described in the licensee's application, as supplemented, and the NRC staff's safety evaluation attached to this amendment. This update shall include the following statement:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

The licensee shall submit the revised description authorized by this amendment with the next update of the UFSAR.

3. This license amendment is effective as of its date of issuance and shall be implemented within 120 days from the date of issuance. The UFSAR changes shall be implemented in the next periodic update to the UFSAR in accordance with 10 CFR 50.71(e).

FOR THE NUCLEAR REGULATORY COMMISSION



Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Date of Issuance: July 19, 2016



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 285 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-35

AMENDMENT NO. 281 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-52

AMENDMENT NO. 289 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-9

AMENDMENT NO. 268 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-17

AMENDMENT NO. 401 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-38

AMENDMENT NO. 403 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-47

AMENDMENT NO. 402 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-55

DUKE ENERGY CAROLINAS, LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-269, 50-270, AND 50-287

1.0 INTRODUCTION

By letter dated July 15, 2015 (Reference 1), as supplemented by letter dated February 1, 2016 (Reference 2) Duke Energy Carolinas, LLC (the licensee) submitted a license amendment request (LAR) to make changes to the facilities as described in the updated final safety analysis report (UFSAR) for the Catawba Nuclear Station, Units 1 and 2 (Catawba); the McGuire Nuclear Station, Units 1 and 2 (McGuire); and the Oconee Nuclear Station, Units 1, 2, and 3 (Oconee).

The proposed changes would provide non-loss-of-coolant accident (LOCA) gap release fractions for high-burnup fuel rods (i.e., 54 gigawatt-days per metric ton of uranium (GWD/MTU)) that exceed the 6.3 kilowatts per foot (kW/ft) linear heat generation rate (LHGR) limit stated in Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (Reference 3), Table 3, "Non-LOCA Fraction of Fission Product Inventory in Gap," Footnote 11.

Specifically, the licensee's request would increase the Table 3 non-LOCA gap fractions to allow LHGRs up to 7.0 kW/ft for rod burnup between 54 and 60 GWD/MTU and 6.9 kW/ft for rod burnup between 60 and 62 GWD/MTU. The licensee's request limited the use of higher LHGRs to no more than 25 fuel rods per fuel assembly.

The supplemental letter dated February 1, 2016, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the U.S. Nuclear Regulatory Commission (NRC) staff's original proposed no significant hazards consideration determinations as published in the *Federal Register* on October 13, 2015 (80 FR 61480).

2.0 REGULATORY EVALUATION

In performing its technical and safety review, the NRC staff evaluated the licensee's design-basis accident (DBA) alternate source term (AST) accident analysis for compliance with the following regulations and adherence to the following NRC acceptable dose consequence analysis assumptions and methods as described in the applicable regulatory codes, guides, standards, and approved precedents.

2.1 Regulatory Requirements

Section 50.67, "Accident source term," of Title 10 to the *Code of Federal Regulations* (10 CFR), paragraph (a)(2) states, in part:

- (i) An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of 0.25 Sv [Sievert] (25 rem) total effective dose equivalent (TEDE).
- (ii) An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage), would not receive a radiation dose in excess of 0.25 Sv (25 rem) total effective dose equivalent (TEDE).
- (iii) Adequate radiation protection is provided to permit access to and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) for the duration of the accident.

Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants" (GDC) 19, "Control room," states, in part:

A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident. Equipment at appropriate locations outside the control room shall be provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

Applicants for and holders of construction permits and operating licenses under this part ... or holders of operating licenses using an alternative source term under § 50.67, shall meet the requirements of this criterion, except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed 0.05 Sv (5 rem) total effective dose equivalent (TEDE) as defined in § 50.2 for the duration of the accident.

The principal design criteria (PDC) for Oconee were developed in consideration of the 70 GDC for Nuclear Power Plant Construction Permits proposed by the Atomic Energy Commission (AEC) in a proposed rulemaking published for 10 CFR Part 50 in the *Federal Register* on July 11, 1967. Oconee UFSAR Section 3.1.11 discusses how Oconee meets PDC 11, which is equivalent to GDC 19. Section 3.1 of the Catawba and McGuire UFSARs discuss how each facility meets the criterion of GDC 19.

Section 100.11, "Determination of exclusion area, low population zone, and population center distance," of 10 CFR, paragraph (a) states, in part:

- (a) As an aid in evaluating a proposed site, an applicant should assume a fission product release¹ from the core, the expected demonstrable leak rate from the containment and the meteorological conditions pertinent to his site to derive an exclusion area, a low population zone and population center distance.

¹ The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

2.2 Approved Guidance

Except where the licensee has proposed a suitable alternative, the NRC staff utilized the regulatory guidance in the following documents in performing this review:

NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants" (Reference 4), provides a more realistic estimate of the source term released into containment in terms of timing, nuclide types, quantities, and chemical form, given a severe core-melt accident that could be applied to a pressurized light water reactor design.

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (Standard Review Plan). Specific sections include the following:

- Section 6.4, "Control Room Habitability System" (Reference 5), provides guidance on reviewing control room (CR) habitability systems with respect to DBAs; and,
- Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms" (Reference 6), provides DBA-specific TEDE dose criteria.

RG 1.183 provides guidance for the applicable DBAs applying an AST. RG 1.183, Table 3, Footnote 11 states:

The release fractions listed here have been determined to be acceptable for use with currently approved LWR [light-water reactor] fuel with a peak burnup up to 62,000 MWD/MTU provided that the maximum linear heat generation rate does not exceed 6.3 kw/ft peak rod average power for burnups exceeding 54 GWD/MTU. As an alternative, fission gas release calculations performed using NRC-approved methodologies may be considered on a case-by-case basis. To be acceptable, these calculations must use a projected power history that will bound the limiting projected plant-specific power history for the specific fuel load. For the BWR rod drop accident and the PWR rod ejection accident, the gap fractions are assumed to be 10 [percent] for iodines and noble gases.

RG 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants" (Reference 7), provides guidance on methods acceptable to the NRC staff for determining atmospheric relative concentration (χ/Q) values in support of design-basis control room radiological habitability assessments at nuclear power plants performed in support of applications for licenses and license amendment requests.

NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments" (Reference 8), is incorporated into the analysis code, Radionuclide Transport and Removal and Dose Estimation (RADTRAD). Reduction in airborne radioactivity in the containment by natural deposition within the containment may be credited. The prior practice of deterministically assuming that a 50 percent plate-out of iodine is released from the fuel is no longer acceptable to the NRC staff, as it is inconsistent with the characteristics of the revised source terms.

2.3 Background on Alternative Source Term Requirements

The evaluation of the release of fission products into containment (called "source term") is used for judging the acceptability of both the plant site and the effectiveness of engineered safety features. In the past, power reactor licensees have typically used AEC Technical Information Document (TID) 14844, "Calculation of Distance Factors for Power and Test Reactor Sites" (Reference 9), dated March 23, 1962, as the basis for DBA source terms. DBAs are based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events that would result in potential hazards not exceeded by those from any accident considered credible. The DBA offsite radiological dose consequences are evaluated against the guideline dose values, in terms of whole body and thyroid dose, given in 10 CFR 100.11, which references TID-14844.

In December 1999, the NRC issued a new regulation, 10 CFR 50.67, which provided a mechanism for licensed power reactors to replace the traditional accident source term used in their DBA analyses with an AST. Regulatory guidance for the implementation of the AST is provided in RG 1.183, as discussed above. A full-scope implementation of an AST is a modification of the facility design basis that addresses all characteristics of the AST; that is, composition and magnitude of the radioactive material, its chemical and physical form, and the timing of its release. Full implementation revises the plant licensing basis to specify the AST in place of the previous accident source term and establishes the TEDE as the new acceptance criteria. The TEDE acceptance criterion of 10 CFR 50.67(b)(2) replaces the previous whole body and thyroid dose guidelines of 10 CFR 100.11 to determine the exclusion area boundary, low population zone (LPZ) and population center distance. In addition, holders of operating licenses using an AST under 10 CFR 50.67 shall meet the requirements of Appendix A to 10 CFR Part 50, GDC 19, regarding control room access and occupancy. This applies not only to the analyses performed in the initial implementation of the AST but also to all future design-basis analyses.

The NRC approved full-scope implementation of the AST for Catawba by letter dated September 30, 2005 (Reference 10), for McGuire by letter dated March 31, 2009 (Reference 11), and for Oconee by letter dated June 1, 2004 (Reference 12). This safety evaluation (SE) input addresses the impact of the proposed changes on previously analyzed DBA radiological consequences and the acceptability of the revised analysis results. Therefore, the regulatory requirements for which the NRC staff based its acceptance are the accident dose criteria stated in 10 CFR 50.67, as supplemented by accident-specific criteria in Section 15 of NUREG-0800, and GDC 19, as supplemented by Section 6.4 of the Standard Review Plan (SRP).

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request

Section 2 of Enclosure 1 to the licensee's letter dated July 15, 2015, states, in part:

This License Amendment Request (LAR) proposes gap release fractions for high-burnup fuel rods (i.e., greater than 54 GWD/MTU) that exceed the 6.3 kW/ft

LHGR limit in Footnote 11 of Table 3 in Regulatory Guide 1.183 ("Non-LOCA Fraction of Fission Product Inventory in Gap"). Footnote 11 states:

As an alternative [to the non-LOCA gap fractions in Table 3 and the limits of Footnote 11], fission gas release calculations performed using NRC-approved methodologies may be considered on a case-by case basis. To be acceptable, these calculations must use a projected power history that will bound the limiting projected plant-specific power history for the specific fuel load.

Duke Energy proposes to increase non-LOCA gap fractions for a maximum of 25 high-burnup fuel rods (i.e., greater than 54 GWD/MTU) in each fuel assembly that operates in the Catawba, McGuire and Oconee reactors. A detailed technical evaluation is provided in Section 3.1. The increases are as follows:

- The values in Regulatory Guide 1.183, Table 3 will be tripled for ^{85}Kr , ^{133}Xe , ^{134}Cs , and ^{137}Cs .
- The values in Regulatory Guide 1.183, Table 3 will be doubled for all other radioisotopes.

These increased gap fractions allow LHGRs up to 7.0 kW/ft for rod burnup between 54 and 60 GWD/MTU, and 6.9 kW/ft for rod burnup between 60 and 62 GWD/MTU. Future fuel cycle designs for Catawba, McGuire and Oconee may include up to 25 fuel rods per fuel assembly operated at LHGRs up to the proposed limits.

3.2 NRC Staff's Review

The NRC staff reviewed the regulatory and technical analyses as related to the radiological consequences of DBAs performed by the licensee in support of its LAR. The NRC staff reviewed the assumptions, inputs, and methods used by the licensee to assess the impact of the proposed changes, performing independent calculations to confirm the conservatism of the analyses.

3.2.1 Non-LOCA Gap Fractions Analysis

In review of the LAR, the NRC staff determined an audit of the supporting calculations and documents was necessary. The NRC staff held an audit from October 26, 2015, through October 28, 2015, at the licensee's offices in Charlotte, North Carolina, to review the supporting documentation and calculation files for this application. More information regarding the audit can be found in the Audit Plan dated October 22, 2015 (Reference 13), and the Audit Summary Report dated March 21, 2016 (Reference 14).

During the audit, the NRC staff reviewed Duke Energy Calculation DPC-1201.30-00-0014, "Fission Gas Release Calculation to Support Exceeding Reg. Guide 1.183 High Burnup LHR Limit," Revision 0, dated October 1, 2014. This engineering calculation documents the technical basis, the assumptions, and bases employed for the gap release analysis for the final gap

fractions provide in the application. As stated in the calculation, the following assumptions and bases were employed for the gap release analysis:

1. Nominal (i.e., best estimate) fuel rod design/operational input was used for the PAD and COPERNIC models.
2. The Catawba, McGuire, and Oconee rod operational power histories selected for this analysis bound the limiting plant-specific power histories, in accordance with Footnote 11 to Table 3 of RG 1.183.
3. The RG 1.183 fuel rod LHGR limit above 54 GWD/MTU burnup (i.e., 6.3 kW/ft) is associated with the heat produced in the fuel (~ 0.973 fraction of total power produced) and does not include energy deposited directly to the coolant.
4. It is sufficient to characterize the inventories of short half-life isotopes (e.g., ¹³¹I) as dependent only on instantaneous power level. Any burnup-dependent effects were deemed negligible or otherwise dispositioned.
5. For each of the Catawba, McGuire, and Oconee reactors, 102 percent of nominal original reactor power was used as the "baseline" operating power in PAD and COPERNIC. This bounds the measurement uncertainty recapture power uprates that have been, or will be, implemented at the sites. The 102 percent power corresponds to 3,479 megawatts thermal (MWt) for Catawba and McGuire, and 2,619 MWt for Oconee.
6. For sufficient detail in the gap fraction calculations, all fuel rod evaluations were performed using 24 equally-spaced axial fuel segments and 10 (PAD) or 15 (COPERNIC) equal-volume radial rings in the fuel pellet. The American National Standards Institute (ANSI)/American Nuclear Society (ANS) Standard ANSI/ANS-5.4-1982, "Method for Calculating the Fractional Release of Volatile Fission Products from Oxide Fuel," (ANS-5.4 (1982)) requires at least 6 radial nodes of equal volume, while the ANSI/ANS-5.4-2011 (ANS-5.4 (2011)) standard requires at least 7 equal-volume radial nodes. Both standards require 10 or more axial nodes of equal length for the gap fraction computations.
7. Fuel assembly axial burnup and power data from recent core designs were employed to determine appropriate axial power shapes for the fuel performance codes.
8. Steady state reactor power operation was assumed for applicability to fuel handling accidents. No major transients are considered that could release significant quantities of volatile fission products to the fuel rod gap.
9. For each of the isotopes considered, the highest gap fraction was taken from variations on central fuel enrichment, presence, or absence of integral poisons and gas release computational method (ANS-5.4 (1982) versus ANS-5.4 (2011)).
10. The thermal conductivity degradation (TCD) model in the PAD code is assumed to be valid, even though the model has not been reviewed by the NRC for the current licensed version of PAD. In Section 3.1.3 of the submittal, gapfrac results from the TCD cases with fuel

temperatures generated by PAD were compared with those generated by COPERNIC to verify the adequacy of this assumption.

During the audit, the NRC staff requested that the licensee identify which portions of the calculations (i.e., COPERNIC, PAD4TCD, gapfrac, etc.) employed each of the above assumptions. The licensee responded that all assumptions, excluding 2, 4, 8, and 10, are directly applicable to the previously listed codes. The remaining assumptions and bases provided information and insight to the case setup or programming of the used codes. The source information for assumption 7 was also examined during the audit.

The NRC staff questioned how assumption 2 would be enforced for each plant. During the audit, the NRC staff determined that the power profiles from the calculation were developed to bound the "limiting project plant-specific power history for the specific fuel load" per Footnote 11 of RG 1.183. This limiting plant-specific power history is provided in the reload design safety analysis report document that is prepared with each cyclical core design for Catawba, McGuire, and Oconee, and incorporated into the reload design.

The NRC staff reviewed the calculational notes for the "gapfrac" EXCEL/VBA code, an application that computes the gap fractions using the ANS-5.4 standards. The licensee stated in the calculational notes that an additional check on the validity of the gap releases computed by PAD, COPERNIC, and gapfrac were made. A graphical representation in the calculational notes was reviewed and displayed agreement between the gas release calculations of both PAD and gapfrac for the ANS-5.4 (1982) model.

Results from the COPERNIC, PAD, and gapfrac were all graphically represented in Figures 5, 6, and 8 of Enclosure 1 to the licensee's letter dated July 15, 2015. The NRC staff reviewed these figures and determined that there was good agreement among the different codes and fuel types for Pacific Northwest National Laboratory (PNNL) Report PNNL-18212, Revision 1, "Update to Gap Release Fractions for Non-LOCA Events Utilizing the Revised ANS 5.4 Standard" (Reference 15), bounding PWR power profile. The NRC staff found that the gap fractions shown in the calculational notes also compare favorably with the FRAPCON results for the PNNL-18212 Figure 2.5 PWR power profile.

The licensee performed numerous calculations encompassing a wide range of fuel rod configurations and analytical techniques. The results from these calculations were entered into the gapfrac code. During the audit, the NRC staff examined gapfrac line-by-line and compared it to the ANS-5.4 standards and found no discrepancies. Also during the audit, the NRC staff verified the modifications to diffusion coefficients for isotopes such as Iodine and Cesium within gapfrac. In addition, the NRC staff reviewed the licensee's calculations and determined that the ANS-5.4 (2011) standard was applied correctly.

The NRC staff compared the gapfrac calculations to the RG 1.183 radionuclide inventories and found that they were consistent. Additionally, the results were consistent with the PNNL-18212 report, which implemented the latest ANS-5.4 standard. The licensee conservatively used the limiting results from both ANS standards. These calculations from gapfrac confirm the conservatism and adequacy of the multipliers proposed by the licensee.

Based on the results of its audit, the NRC staff performed confirmatory analysis using FRAPCON 4.0 to provide context to the trends provided in the LAR. The NRC staff recognized that input differences may introduce biases in this benchmark, but overall trends should be comparable. The NRC staff's independent FRAPCON 4.0 calculations verified that the licensee's proposed multipliers on the RG 1.183 gap fractions are conservative and appropriate.

For each radionuclide, the licensee has elected to select the larger value calculated using ANS-5.4 (1982) and ANS-5.4 (2011) standards. Based on its confirmatory calculations, the NRC staff concludes that this approach is conservative. Based on the discussion during the audit, the NRC staff found that the licensee's allowable rod power history is much more benign than the Draft Regulatory Guide (DG)-1199, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants (Proposed Revision 1 of Regulatory Guide 1.183)" (Reference 16), rod power envelope. However, the predicted ^{131}I is twice as large (2x multiplier on 8.0 percent). This is attributed to the differences between ANS-5.4 (1982) and ANS-5.4 (2011). For the long-lived isotopes (^{85}Kr and Cesium), the licensee's proposed gap fractions are smaller than those in DG-1199. The lower gap fraction of longer-lived isotopes used by the licensee are a result of using the two ANS-5.4 standards and the restrictive power envelope. Comparisons to prior calculations provided assurance that the licensee's proposed multipliers on the RG 1.183 gap fractions are conservative and appropriate.

During the audit, the NRC staff reviewed the licensee's underlying engineering calculations, performed independent FRAPCON 4.0 calculations, and compared results to previous FRAPCON 3.4 calculations. Based on the results of the confirmatory calculations, the NRC staff finds that the analytical technique, inputs, and assumptions used in the licensee's calculations are conservative, appropriate, and consistent with both ANS-5.4 (1982) and ANS-5.4 (2011). Therefore, the NRC staff concludes that the proposed multipliers on the RG 1.183 gap inventories are acceptable.

In its LAR, the licensee stated that the application of the gap fraction multipliers allow LHGRs up to 7.0 kW/ft for rod burnup between 54 and 60 GWD/MTU and 6.9 kW/ft for rod burnup between 60 and 62 GWD/MTU. The licensee then states that future fuel cycle designs for Catawba, McGuire, and Oconee may include up to 25 fuel rods per fuel assembly operated at LHGRs up to the proposed limits. Based on the review of the LAR and the confirmatory calculations performed after the audit, the NRC staff concludes that the licensee's proposed changes to the facilities as described in the UFSARs are acceptable. Furthermore, based upon the level of conservatism in these multipliers, the NRC staff also concludes that application of these multipliers to up to 25 fuel rods per fuel assembly as discussed in the LAR for future fuel cycle designs is acceptable.

3.2.2 DBA Radiological Consequences Analyses

As discussed above, the NRC staff has reviewed the licensee's proposed revisions to provide non-LOCA gap fractions for high-burnup fuel rods greater than 54 GWD/MTU that exceed the 6.3 kW/ft LHGR limit detailed in Footnote 11 in Table 3 of RG 1.183. Based on this review, the NRC staff concluded that the proposed increase to the RG 1.183, Table 3, non-LOCA gap fractions is acceptable. After reaching this conclusion, the NRC staff applied the proposed non-LOCA gap fractions to assess the dose consequences for fuel handling type accidents at

Catawba, McGuire, and Oconee in which the damaged fuel assemblies include fuel rods operated beyond the RG 1.183, Table 3 LHGR limit as discussed below.

When approved, the new non-LOCA gap release fractions allow LHGRs up to 7.0 kW/ft for rod burnup between 54 and 60 GWD/MTU and 6.9 kW/ft for rod burnup between 60 and 62 GWD/MTU. Upon approval of the licensee's LAR, future fuel cycle designs for Catawba, McGuire, and Oconee may include up to 25 fuel rods per fuel assembly operated at LHGRs up to this proposed limit. The increased non-LOCA gap fractions are as follows:

- values will be tripled for ⁸⁵Kr, ¹³³Xe, ¹³⁴Cs, and ¹³⁷Cs, and
- values will be doubled for all other radioisotopes.

Table 1 lists side-by-side the original RG 1.183, Table 3, non-LOCA gap fractions and the licensee-revised non-LOCA gap fractions.

Table 1: Original RG 1.183, Table 3, and the Licensee-Revised Non-LOCA Gap Fractions

Radionuclide Group	Gap Fraction from Table 3 of RG 1.183 (Rev. 0)	Bounding Gap Fraction from Section 3.1.3	Ratio
¹³¹ I	0.08	0.16	2
⁸⁵ Kr	0.10	0.30	3
¹³³ Xe (other Noble)	0.05	0.15	3
Other Noble Gases	0.05	0.10	2
Other Halogens	0.05	0.10	2
¹³⁴ Cs (Alkali Metal)	0.12	0.36	3
¹³⁷ Cs (Alkali Metal)	0.12	0.36	3
Other Alkali Metals	0.12	0.24	2

3.2.2.1 Fuel Handling Accident Analysis Summary

The fuel handling accident (FHA) analysis postulates that a spent fuel assembly (or bundle of fuel assemblies) is assumed to be damaged during fuel handling. This accident may take place either in the containment building or the spent fuel pool. The affected assemblies are assumed to be those with the highest inventory of fission products in the core. Volatile constituents of the core fission product inventory migrate from the fuel pellets to the gap between the pellets and the fuel rod clad during normal power operations. All of the fuel rods in the dropped assembly are conservatively assumed to experience fuel cladding damage, releasing the radionuclides within the fuel rod gap to the fuel pool or reactor cavity water. Fission products released from the damaged fuel are decontaminated by passage through the overlaying water in the reactor cavity or spent fuel pool, depending on their physical and chemical form. The remaining activity not decontaminated by passage through the overlaying water is assumed to be released directly to the outside atmosphere (environment) at a constant rate over a 2-hour period.

The affected FHA DBAs for Catawba, McGuire, and Oconee are as follows:

Catawba:

- Fuel handling accident outside containment,
- Fuel handling accident inside containment,
- Weir gate drop, and
- Spent fuel cask drop.

McGuire:

- Fuel handling accident inside containment,
- Fuel handling accident in the fuel building,
- Weir gate drop,
- Spent fuel cask drop, and
- Tornado missile impact - spent fuel analysis.

Oconee:

- Fuel handling accident (single assembly event) and
- Fuel cask handling accident (multiple assembly event).

3.2.2.2 Fuel Handling Accident Source Term

The fuel handling accident source term is developed from the core source term and follows the guidance of RG 1.183, Regulatory Position 3.1, which states that the fission product inventory of each damaged fuel rod for DBA events that do not involve the entire core is determined by dividing the total core inventory by the number of rods in the core. For each of the Catawba, McGuire, and Oconee reactors, 102 percent of nominal original reactor power was used as the "baseline" operating power. This bounds the measurement uncertainty recapture power uprates that have been, or will be, implemented at the sites. The 102 percent power corresponds to 3,479 MWt for Catawba and McGuire and 2,619 MWt for Oconee. Consistent with RG 1.183, Regulatory Position 3.2, to account for differences in power level across the core, a radial peaking factor of 1.65 is applied to the inventory of the damaged rods. The licensee limits its request to no more than 25 fuel rods per fuel assembly that could exceed the maximum LHGR of 6.3 kW/ft for burnups exceeding 54 GWD/MTU. Based on the licensee's non-LOCA gap release analysis (see Table 1), the gap release fractions for rods that exceed the 6.3 kW/ft LHGR limit above 54 GWD/MTU are doubled, except for four isotopes: ^{85}Kr , ^{133}Xe , ^{134}Cs , and ^{137}Cs . The release fractions for these four isotopes are tripled.

3.2.2.3 Fuel Handling Accident Analysis Consequence

The licensee evaluated the radiological consequences resulting from the postulated FHAs for Catawba, McGuire, and Oconee, assuming the proposed increase to the non-LOCA gap release fractions for 25 fuel rods per fuel assembly, concluding that the radiological consequences at the exclusion area boundary (EAB), LPZ, and CR are within the dose guidelines provided in 10 CFR 50.67 and accident-specific dose criteria specified in SRP Section 15.0.1. The NRC staff's review finds that the licensee's analysis assumptions and inputs are consistent with RG 1.183. The NRC staff finds that the EAB, LPZ, and CR doses estimated provided by the licensee for the FHAs meet the applicable accident dose criteria

discussed above in 10 CFR 50.67 and the accident-specific criterion of RG 1.183, and are, therefore, acceptable. For the FHA event, the TEDE criteria are 6.3 rem at the EAB for the worst 2 hours, 6.3 rem at the LPZ for the duration of the accident, and 5 rem in the CR for the duration of the accident. The licensee's calculated TEDE dose results are given in Table 2 below.

Table 2: Fuel Handling DBA Dose Consequences

Accident	Baseline Dose (Rem TEDE)			Revised Doses (Rem TEDE)		
	EAB	LPZ	CR	EAB	LPZ	CR
Catawba Nuclear Station						
Fuel Handling Accident	1.59	NA ¹	2.37	1.76	NA ¹	2.59
Weir Gate Drop	2.44	NA ¹	3.87	2.68	NA ¹	4.24
Cask Drop	0.005	0.0007	0.001	0.006	0.0008	0.001
McGuire Nuclear Station						
Fuel Handling Accident	2.95	0.27	3.52	3.25	0.29	3.86
Weir Gate Drop	5.60	0.51	2.97	6.16	0.56	3.25
Cask Drop	0.009	0.0008	0.0005	0.01	0.0009	0.0006
Tornado Missile Accident	2.58	2.59	4.25	2.84	2.86	4.66
Oconee Nuclear Station						
Fuel Handling Accident	1.18	0.13	2.19	1.33	0.14	2.45
Fuel Cask Accident	1.83	0.19	3.61	2.05	0.22	4.05

¹ The Catawba UFSAR does not report radiation doses at the boundary of the LPZ for these accidents because the EAB is bounding.

Based on a comparison of the results above to the applicable regulatory criteria described in RG 1.183, the NRC staff concludes that there is reasonable assurance that the licensee's estimates of the EAB, LPZ, and CR doses comply with the regulatory requirements.

3.2.3 Implementation Criteria

In its LAR, the licensee requested to use the proposed increases to the non-LOCA gap release fractions for a maximum of 25 fuel rods per fuel assembly. As such, the NRC staff performed its review, including confirmatory calculations, assuming a maximum of 25 fuel rods per fuel assembly. As discussed above, based on this review, the NRC staff concludes that the changes to the UFSARs are acceptable, for a maximum of 25 fuel rods per fuel assembly. However, the NRC staff did not evaluate the LAR, or perform confirmatory calculations assuming that more than 25 fuel rods per fuel assembly use the proposed increases to the non-LOCA gap release fractions. As such, and in accordance with the implementation requirements stated in each license amendment, the licensee shall update the UFSARs to state that:

A maximum of 25 fuel rods, per fuel assembly, shall be allowed to exceed the rod power/burnup criteria of Footnote 11 in RG 1.183 in accordance with the license amendment request submitted by letter dated July 15, 2015.

3.3 Technical Conclusion

As discussed above, the NRC staff evaluated the licensee's proposed revisions to provide gas gap release fractions for high-burnup fuel rods (i.e., greater than 54 GWD/MTU) that exceed the 6.3 kW/ft LHGR limit detailed in Table 3 of RG 1.183, Footnote 11. Based on the considerations above, including the results of the confirmatory calculations, the NRC staff concludes that the proposed revisions are acceptable.

As further described above, the NRC staff reviewed the assumptions, inputs, and methods used by the licensee to assess the radiological consequences of the DBA FHA-type events for Catawba, McGuire, and Oconee using the proposed increases to the non-LOCA gap release fractions for 25 fuel rods per fuel assembly. Based on this review, the NRC staff concludes that the licensee used methods of analysis and assumptions consistent with the conservative regulatory requirements and guidance described in Section 2.0 of this SE. The NRC staff compared the doses estimated by the licensee to the applicable dose guidelines and criteria referenced in Section 2.0 of this SE. Based on that comparison, the NRC staff concludes that there is reasonable assurance that the licensee's estimates of the EAB, LPZ, and CR doses comply with the regulatory requirements. The NRC staff also concludes that there is reasonable assurance that Catawba, McGuire, and Oconee, as modified by the requested license amendments, will continue to provide sufficient safety margins and adequate defense-in-depth under conditions of unanticipated events, and in the presence of the uncertainties in accident progression, assumptions, parameters, and analyses outlined above. Therefore, the NRC staff concludes that the proposed changes to the licensing basis are acceptable with respect to the radiological consequence of the DBA FHA-type events.

Accordingly, the NRC staff concludes that the changes proposed by the licensee in its LAR, as supplemented, to the facilities as described in the UFSARs are acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the North Carolina and South Carolina State officials were notified of the proposed issuance of the amendments. The State officials had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to the installation or use of facility 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, which was published in the *Federal Register* on October 13, 2015 (80 FR 61480). 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. Repko, Regis, Duke Energy, letter to NRC, "License Amendment Request Proposing a New Set of Fission Gas Gap Release Fractions for High Burnup Fuel Rods that Exceed the Linear Heat Generation Rate Limit Detailed in Regulatory Guide 1.183, Table 3, Footnote 11," dated July 15, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15196A093).
2. Repko, Regis, Duke Energy, letter to NRC, "Response to NRC Request for Additional Information (RAI) Regarding Application to Use Alternate Fission Gas Gap Release Fractions," dated February 1, 2016 (ADAMS Accession No. ML16032A011).
3. NRC, Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Plants," July 2000 (ADAMS Accession No. ML003716792).
4. NRC NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," February 1995 (ADAMS Accession No. ML041040063).
5. NRC NUREG-0800, "Standard Review Plan," Section 6.4, "Control Room Habitability System," Revision 3, March 2007 (ADAMS Accession No. ML070550069).
6. NRC NUREG-0800, "Standard Review Plan," Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms," Revision 0, July 2000 (ADAMS Accession No. ML003734190).
7. RG 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," June 2003 (ADAMS Accession No. ML031530505).
8. NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments," July 1996 (ADAMS Accession No. ML100130305).
9. U.S. Atomic Energy Commission Technical Information Document (TID) 14844, "Calculation of Distance Factors for Power and Test Reactor Sites," dated March 23, 1962 (ADAMS Accession No. ML021750625).

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If you have any questions, please contact me by phone at 301-415-4032 or by e-mail at Randy.Hall@nrc.gov.

Sincerely,

/RA/

James R. Hall, Senior Project Manager
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Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413, 50-414, 50-369,
50-370, 50-269, 50-270,
and 50-287

Enclosures:

1. Amendment No. 285 to NPF-35
2. Amendment No. 281 to NPF-52
3. Amendment No. 289 to NPF-9
4. Amendment No. 268 to NPF-17
5. Amendment No. 401 to DPR-38
6. Amendment No. 403 to DPR-47
7. Amendment No. 402 to DPR-55
8. Safety Evaluation

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