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

August 3, 2016

Mr. Adam C. Heflin
President, Chief Executive Officer,
and Chief Nuclear Officer
Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, KS 66839

SUBJECT: WOLF CREEK GENERATING STATION - ISSUANCE OF AMENDMENT RE: USE OF OPTIMIZED ZIRLO™ FUEL ROD CLADDING (CAC NO. MF7285)

Dear Mr. Heflin:

The U.S. Nuclear Regulatory Commission (NRC, the Commission) has issued the enclosed Amendment No. 216 to Renewed Facility Operating License No. NPF-42 for the Wolf Creek Generating Station (WCGS). The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated January 27, 2016, as supplemented by letter dated May 19, 2016, for an exemption and license amendment to use Optimized ZIRLO™ fuel rod cladding material.

The amendment revises the WCGS TSs to allow the use of Optimized ZIRLO™ as an approved fuel rod cladding material. This change is consistent with the NRC's allowed use of Optimized ZIRLO™ fuel rod cladding material as documented in the NRC safety evaluation included in Addendum 1-A to Westinghouse topical report, WCAP-12610-P-A and CENPD-404-P-A, "Optimized ZIRLO™." The NRC staff addressed your exemption request via separate correspondence.

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

Sincerely,

CFLyon

Carl F. Lyon, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosures:
1. Amendment No. 216 to NPF-42
2. Safety Evaluation

cc w/encls: Distribution via Listserv

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WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION

DOCKET NO. 50-482

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 216
License No. NPF-42

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

   A. The application for amendment to the Wolf Creek Generating Station (the facility) Renewed Facility Operating License No. NPF-42 filed by the Wolf Creek Nuclear Operating Corporation (the Corporation), dated January 27, 2016, as supplemented by letter dated May 19, 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 set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, as amended, 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 license 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. NPF-42 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 216, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated in the license. The Corporation shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. The license amendment is effective as of its date of issuance and shall be implemented within 90 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Robert J. Pascarelli, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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

Date of Issuance: August 3, 2016

ATTACHMENT TO LICENSE AMENDMENT NO. 216

RENEWED FACILITY OPERATING LICENSE NO. NPF-42

DOCKET NO. 50-482

Replace the following pages of the Renewed Facility Operating License No. NPF-42 and Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Renewed Facility Operating License

REMOVE	INSERT
4	4

Technical Specifications

REMOVE	INSERT
4.0-1	4.0-1
5.0-26	5.0-26

(5) The Operating Corporation, 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

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

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

(1) Maximum Power Level

The Operating Corporation is authorized to operate the facility at reactor core power levels not in excess of 3565 megawatts thermal (100% power) in accordance with the conditions specified herein.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 216, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated in the license. The Corporation shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) Antitrust Conditions

Kansas Gas & Electric Company and Kansas City Power & Light Company shall comply with the antitrust conditions delineated in Appendix C to this license.

(4) Environmental Qualification (Section 3.11, SSER #4, Section 3.11, SSER #5)*

Deleted per Amendment No. 141.

*The parenthetical notation following the title of many license conditions denotes the section of the supporting Safety Evaluation Report and/or its supplements wherein the license condition is discussed.

4.0 DESIGN FEATURES

4.1 Site Location

4.1.1 The WCGS site is approximately 3.5 miles east of the John Redmond Reservoir in Coffey County, Kansas and is approximately 3.5 miles northeast of the town of Burlington.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy, ZIRLO®, or Optimized ZIRLO™ clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.

4.2.2 Control Rod Assemblies

The reactor core shall contain 53 control rod assemblies. The control rod material shall be silver indium cadmium or hafnium metal as approved by the NRC.

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum nominal U-235 enrichment of 5.0 weight percent. For fuel with enrichments greater than 4.6 nominal weight percent of U-235, the combination of enrichment and integral fuel burnable absorbers shall be sufficient so that the requirements of 4.3.1.1.b are met.

(continued)

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

4. WCAP-10216-P-A, "Relaxation of Constant Axial Offset Control - F_Q Surveillance Technical Specification."

5. WCNOC Topical Report NSAG-007, "Reload Safety Evaluation Methodology for the Wolf Creek Generating Station."

6. NRC Safety Evaluation Report dated March 30, 1993, for the "Revision to Technical Specification for Cycle 7."

7. WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using the Automated Statistical Treatment of Uncertainty Method (ASTRUM)."

8. WCAP-16045-P-A, "Qualification of the Two-Dimensional Transport Code PARAGON."

9. WCAP-16045-P-A, Addendum 1-A, "Qualification of the NEXUS Nuclear Data Methodology."

10. WCAP 10965-P-A, "ANC: A Westinghouse Advanced Nodal Computer Code."

11. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report."

12. WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™."

13. WCAP-8745-P-A, "Design Bases for the Thermal Power ΔT and Thermal Overtemperature ΔT Trip Functions."

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

(continued)

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 216 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-42

WOLF CREEK NUCLEAR OPERATING CORPORATION

WOLF CREEK GENERATING STATION

DOCKET NO. 50-482

1.0 INTRODUCTION

By application dated January 27, 2016 (Reference 1), as supplemented by letter dated May 19, 2016 (Reference 2), Wolf Creek Nuclear Operating Corporation (WCNOC, the licensee) requested changes to the Technical Specifications (TSs) for Wolf Creek Generating Station (WCGS). Portions of the letter dated May 19, 2016, contain sensitive unclassified non-safeguards information and have been withheld from public disclosure pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 2.390. The supplemental letter dated May 19, 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 determination as published in the *Federal Register* on April 12, 2016 (81 FR 21603).

The proposed change would revise TS 4.2.1, "Fuel Assemblies," to allow use of Optimized ZIRLO™ fuel rod cladding at WCGS. The proposed change would also revise TS 5.6.5, "Core Operating Limits Report (COLR)," by adding Addendum 1-A to Westinghouse Electric Company (Westinghouse) Topical Report WCAP-12610-P-A & CENPD-404-P-A, entitled "Optimized ZIRLO™" (Reference 3), to the list of analytical methods previously reviewed and approved by the NRC (Reference 4).

The licensee's application also requested an exemption from specific requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and Appendix K of 10 CFR Part 50, "ECCS Evaluation Models," to allow the use of Optimized ZIRLO™. The NRC staff addressed the licensee's exemption request via separate correspondence (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16179A440).

2.0 REGULATORY EVALUATION

Section 50.36 of 10 CFR requires that TSs be included by applicants for a license authorizing operation of a production or utilization facility. Paragraph 10 CFR 50.36(c) requires that TS include (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements; (4) design features; and (5) administrative controls. The proposed change to TS 4.2.1 is within the design features for fuel assemblies within the reactor core category and the proposed change to TS 5.6.5 is within the administrative controls category.

Appendix A to 10 CFR Part 50, General Design Criterion (GDC) 10, "Reactor design," requires that 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." Specified acceptable fuel design limits are established to ensure that the fuel is not damaged, that is, the fuel rods do not fail and the fuel system dimensions remain within operational tolerances.

Appendix A to 10 CFR Part 50, GDC 27, "Combined reactivity control systems capability," requires that the "reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained."

Appendix A to 10 CFR Part 50, GDC 35, "Emergency core cooling," requires, in part, that a "system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts."

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), Section 4.2, "Fuel System Design," provides regulatory guidance to the NRC staff for the review of fuel rod cladding materials and fuel system. In addition, the SRP provides guidance for compliance with the applicable GDC in Appendix A to 10 CFR Part 50. According to SRP Section 4.2, the fuel system safety review provides assurance that:

- The fuel system is not damaged as a result of normal operation and anticipated operational occurrences (AOOs),
- Fuel system damage is never so severe as to prevent control rod insertion when it is required,
- The number of fuel rod failures is not underestimated for postulated accidents, and
- Coolability is always maintained.

The proposed change to TS 4.2.1 adds Optimized ZIRLO™ to the list of approved fuel rod cladding material. The proposed change to TS 5.6.5 adds Addendum 1-A to Topical Report WCAP-12610-P-A and CENPD-404-P-A, entitled "Optimized ZIRLO™" (Reference 3), to the list of analytical methods previously reviewed and approved by the NRC. The NRC staff has previously reviewed and approved Optimized ZIRLO™ cladding material for application in Westinghouse and Combustion Engineering (CE) fuel assembly designs (Reference 3).

3.0 TECHNICAL EVALUATION

3.1 Proposed Change to TS 4.2.1 and TS 5.6.5

3.1.1 Introduction

The WCGS reactor core consists of 193 fuel assemblies with 53 control rod assemblies. Each fuel assembly is a 17x17 square lattice fuel rod array containing 264 fuel rods, 24 guide thimbles, and one instrument tube. Each fuel assembly is a canless type with the basic assembly consisting of the Rod Cluster Control guide thimbles fastened to grids and top and bottom nozzles. The fuel rods consist of slightly enriched uranium dioxide pellets which are clad in a tube made from zircaloy or ZIRLO™ (also referred to as *standard* ZIRLO™, as compared to *Optimized* ZIRLO™).

The proposed change to TS 4.2.1 will add "Optimized ZIRLO™" to the list of cladding materials listed in the sentence describing the fuel rods. The proposed change to TS 5.6.5 would add Addendum 1-A to Topical Report WCAP-12610-P-A and CENPD-404-P-A, entitled "Optimized ZIRLO™," to the list of analytical methods previously reviewed and approved by the NRC. The NRC staff has approved Optimized ZIRLO™ fuel cladding based upon (1) similarities with standard ZIRLO™, (2) demonstrated material performance, and (3) a commitment to provide irradiated data and validate fuel performance models ahead of burnups achieved in batch applications. The NRC staff has approved numerous similar applications (References 5 through 9).

3.1.2 Treatment of Limitations and Conditions in Addendum 1-A of WCAP-12610

The NRC staff's safety evaluation (SE) for the topical report dated June 10, 2005 (Reference 3), contains ten conditions and limitations. The staff indicated in the SE that licensees referencing Addendum 1-A of WCAP-12610-P-A & CENPD 404-P-A to implement Optimized ZIRLO™ must ensure compliance with the ten conditions and limitations. In its application, the licensee has documented compliance with these ten conditions and limitations and has committed to ensuring compliance for future reloads in Reference 1. Each condition and limitation is restated below along with the NRC staff's evaluation of WCNOC's response.

3.1.2.1 Condition and Limitation 1

Exemption

Until rulemaking to 10 CFR Part 50 addressing Optimized ZIRLO™ has been completed, implementation of Optimized ZIRLO™ fuel clad requires an exemption from 10 CFR 50.46 and 10 CFR Part 50 Appendix K.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 1

Because WCNOC has submitted an exemption request for WCGS, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.2 Condition and Limitation 2

Burnup Limit

The fuel rod burnup limit for this approval remains at currently established limits 62 GWd/MTU for Westinghouse fuel designs and 60 [Gigawatt days per metric ton unit (GWd/MTU)] for CE fuel designs.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 2

Because WCGS uses a Westinghouse fuel design (and not a CE fuel design) and WCNOC has confirmed that WCGS will continue to use a 62 GWd/MTU rod burnup, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.3 Condition and Limitation 3

Corrosion Limit

The maximum fuel rod waterside corrosion, as predicted by the best-estimate model, will [satisfy proprietary limits included in the topical report and proprietary version of the SE] of hydrides for all locations of the fuel rod.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 3

Because WCNOC has confirmed that the maximum fuel rod waterside corrosion limit is verified to be less than the specified proprietary limits for all fuel rod locations as a normal part of the reload design process, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.4 Condition and Limitation 4

Conditions on Approved Methodologies

All the conditions listed in previous NRC SE approvals for methodologies used for standard ZIRLO™ and Zircaloy-4 fuel analysis will continue to be met, except that the use of Optimized ZIRLO™ cladding in addition to standard ZIRLO™ and Zircaloy-4 cladding is now approved.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 4

Because WCNOC has confirmed that future analysis using Optimized ZIRLO™ will continue to meet all conditions assorted with approved methods, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.5 Condition and Limitation 5

Application Domain

All methodologies will be used only within the range for which ZIRLO™ and Optimized ZIRLO™ data were acceptable and for which the verifications discussed in Addendum 1 and responses to [requests for additional information (RAIs)] were performed.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 5

Because WCNOC has confirmed that the application of Optimized ZIRLO™ will be consistent with the approach accepted in WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A and that confirmation of these conditions is part of the normal reload design process, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.6 Condition and Limitation 6

LTA [Lead Test Assembly] Data

The licensee is required to ensure that Westinghouse has fulfilled the following commitment: Westinghouse shall provide the NRC staff with a letter(s) containing the following information (Based on the schedule described in response to RAI #3):

a. *Optimized ZIRLO™ LTA data from Byron, Calvert Cliffs, Catawba, and Millstone.*

   i. *Visual*
   ii. *Oxidation of fuel rods*
   iii. *Profilometry*
   iv. *Fuel rod length*
   v. *Fuel assembly length*

b. *Using the standard and Optimized ZIRLO™ database including the most recent LTA data, confirm applicability with currently approved fuel performance models (e.g., measured vs. predicted).*

Confirmation of the approved models' applicability up through the projected end of cycle burnup for the Optimized ZIRLO™ fuel rods must be completed prior to their initial batch loading and prior to the startup of subsequent cycles. For example, prior to the first batch application of Optimized ZIRLO™, sufficient LTA data may only be available to confirm the models' applicability up through 45 GWd/MTU. In this example, the licensee would need to confirm the models up through the end of the initial cycle. Subsequently, the licensee would need to confirm the models, based upon the latest LTA data, prior to re-inserting the Optimized ZIRLO™ fuel rods in future cycles. Based upon the LTA schedule, it is expected that this issue may only be applicable to the first few batch implementations since sufficient LTA data up through the burnup limit should be available within a few years.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 6

Westinghouse has submitted numerous documents to the NRC to supply this information in various stages:

- LTR-NRC-07-1 (Reference 10) – This submittal includes information from the complete Byron LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (1 cycle), Catawba LTA (1 cycle), and Millstone LTA (1 cycle).

- LTR-NRC-07-58 (Reference 11) – This submittal includes information from the complete Byron LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (1 cycle), Catawba LTA (2 cycles), and Millstone LTA (2 cycles).

- LTR-NRC-07-58, Revision 1 (Reference 12) – This submittal includes information from the complete Byron LTA (3 cycles). It also included updated information from the ongoing Calvert Cliffs LTA (1 cycle), Catawba LTA (2 cycles), and Millstone LTA (2 cycles).

- LTR-NRC-08-60 (Reference 13) – This submittal includes information from the complete Byron LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (2 cycle), Catawba LTA (2 cycles), and Millstone LTA (2 cycles).

- LTR-NRC-10-53 (Reference 14) - This submittal includes information from the complete Byron LTA (3 cycles), Catawba LTA (3 cycles), and Millstone LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (3 cycles).

- LTR-NRC-13-6 (Reference 15) – This submittal includes information from the complete Byron LTA (3 cycles), Catawba LTA (3 cycles), Millstone LTA (3 cycles), and Calvert Cliffs LTA (3 cycles).

- LTR-NRC-15-7 (Reference 16) – This submittal provides the responses to RAIs received in response to letter LTR-NRC-13-6 (Reference 15), which was issued to fulfill Conditions 6 and 7 of WCAP-12610- P-A & CENPD-404-P-A Addendum 1-A (Reference 3).

The LTA measurements showed the corrosion rate of the stress-relief annealed (SRA) Optimized ZIRLO™ and partially-re-crystallized annealed (PRXA) Optimized ZIRLO™ to be significantly lower than that of the standard ZIRLO™. Similarly, the measured SRA/PRXA Optimized ZIRLO™ fuel rod growth is also within the predictive capability of the standard ZIRLO™ fuel rod growth model as the measured values are well within the scatter band of the standard ZIRLO™ fuel rod growth database. Based on the measurements and evaluations of LTA data, the NRC staff finds that the licensee has demonstrated acceptable in-reactor performance and that the fuel rod and assembly design calculations remain valid and the Optimized ZIRLO™ fuel will operate within design criteria.

By submitting this information, the models' applicability has been confirmed for burnups up to 62 GWD/MTU for Westinghouse fuels. None of the visual inspection showed anomalies. The measurements of oxidation measurements demonstrated that the oxide thickness of Optimized ZIRLO™ was bounded by that of ZIRLO™. The profilometry data demonstrated that the growth of Optimized ZIRLO™ was bounded by that of ZIRLO™ and was appropriately bounded by Performance Analysis and Design (PAD). The measurements of axial growth demonstrated that the Optimized ZIRLO™ assemblies were within the upper and lower growth bounds. Based on this information, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.7 Condition and Limitation 7

Cycle Data

The licensee is required to ensure that Westinghouse has fulfilled the following commitment: Westinghouse shall provide the NRC staff with a letter containing the following information (Based on the schedule described in response to RAI #11):

a. Vogtle growth and creep data summary reports.

b. Using the standard ZIRLO™ and Optimized ZIRLO™ database including the most recent Vogtle data, confirm applicability with currently approved fuel performance models (e.g., level of conservatism in W rod pressure analysis, measured vs. predicted, predicted minus measured vs. tensile and compressive stress).

Confirmation of the approved models' applicability up through the projected end of cycle burnup for the Optimized ZIRLO™ fuel rods must be completed prior to their initial batch loading and prior to the startup of subsequent cycles. For example, prior to the first batch application of Optimized ZIRLO™, sufficient LTA data may only be available to confirm the models' applicability up through 45 GWd/MTU. In this example, the licensee would need to confirm the models up through the end of the initial cycle. Subsequently, the licensee would need to confirm the models, based upon the latest LTA data, prior to re-inserting the Optimized ZIRLO™ fuel rods in future cycles. Based upon the LTA schedule, it is expected that this issue may only be applicable to the first few batch implementations since sufficient LTA data up through the burnup limit should be available within a few years.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 7

Westinghouse has submitted numerous documents to the NRC to supply this information in various stages:

- LTR-NRC-07-1 (Reference 10) – This submittal includes information from the complete Byron LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (1 cycle), Catawba LTA (1 cycle), and Millstone LTA (1 cycle).

- LTR-NRC-07-58 (Reference 11) – This submittal includes information from the complete Byron LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (1 cycle), Catawba LTA (2 cycles), and Millstone LTA (2 cycles).

- LTR-NRC-07-58, Revision 1 (Reference 12) – This submittal includes information from the complete Byron LTA (3 cycles). It also included updated information from the ongoing Calvert Cliffs LTA (1 cycle), Catawba LTA (2 cycles), and Millstone LTA (2 cycles).

- LTR-NRC-08-60 (Reference 13) – This submittal includes information from the complete Byron LTA (3 cycles). It also included information from the ongoing

Calvert Cliffs LTA (2 cycle), Catawba LTA (2 cycles), and Millstone LTA (2 cycles).

- LTR-NRC-10-53 (Reference 14) - This submittal includes information from the complete Byron LTA (3 cycles), Catawba LTA (3 cycles), and Millstone LTA (3 cycles). It also included information from the ongoing Calvert Cliffs LTA (3 cycles).

- LTR-NRC-13-6 (Reference 15) – This submittal includes information from the complete Byron LTA (3 cycles), Catawba LTA (3 cycles), Millstone LTA (3 cycles), and Calvert Cliffs LTA (3 cycles).

- LTR-NRC-15-7 (Reference 16) – This submittal provides the responses to RAIs received in response to letter LTR-NRC-13-6 (Reference 15), which was issued to fulfill Conditions 6 and 7 of WCAP-12610- P-A & CENPD-404-P-A Addendum 1-A (Reference 3).

One of the main objectives of the ongoing Westinghouse creep program is to demonstrate that Optimized ZIRLO™ creep is the same as standard ZIRLO™, and that the creep in tension is similar to creep in compression. Westinghouse concluded in LTR-NRC-13-6 (Reference 15) that the PAD 4.0 creep model does not extrapolate well to the low temperatures at which the Vogtle capsule operates. However, the PAD 4.0 model provides acceptable results in the high temperature region that is typically limiting for fuel performance analyses. Section 3.3 of LTR-NRC-13-6 summarizes creep/growth results based on currently available data for (1) the irradiation growth and creep of standard ZIRLO™ and PRXA Optimized ZIRLO™ and (2) the irradiation creep of standard ZIRLO™ under tensile and compressive deviatoric (differential) hoop stresses. The irradiation creep was measured using samples filled with helium gas. The internal gas pressure was either below or above system pressure so that the samples were in either compressive or tensile hoop stress, respectively.

Figures 14-17 of LTR-NRC-13-6 (as amended by Attachment 2 of LTR-NRC-15-7 in Reference 16) presents the diameter irradiation creep data for standard ZIRLO™, PRXA Optimized ZIRLO™, and SRA Optimized ZIRLO™ under compressive stress. In response to a staff request (RAI #3a of LTR-NRC-15-7), Westinghouse provided similar irradiation creep data under tensile stress. The measured data show that the diameter irradiation creep for PRXA Optimized ZIRLO™ cladding and SRA ZIRLO cladding are similar under both compression and tension stresses.

Figures 18 to 21 of LTR-NRC-13-6 (as amended by Attachment 2 of LTR-NRC-15-7) present an evaluation of the irradiation creep data for standard ZIRLO™ for tensile and compressive deviatoric hoop stresses. In response to an NRC staff request (RAI #4 of LTR-NRC-15-7), Westinghouse provided similar irradiation creep data for PRXA Optimized ZIRLO™. All of these figures show that the data are very consistent between stress levels, the strain behavior is linear as a function of the deviatoric (differential) hoop stress, and the regression fits to the data approximately exhibit zero strain when the deviatoric hoop stress is zero, demonstrating that compressive and tensile creep are equivalent.

Section 4.0 of LTR-NRC-15-7 describes the analytical evaluations relating the measured Vogtle and other ZIRLO™ creep and growth profilometry data to the Westinghouse licensed fuel performance models (PAD 4.0 and FATES3B) to assess the ability of the existing creep models to predict the data. In response to the NRC staff's concerns regarding the comparison of data trends based on deviatoric stress and model predictions based on total hoop stress (RAI #5 of LTR-NRC-15-7), Westinghouse stated that limitations with the existing creep model would be addressed in PAD5 (currently under review). In RAI #7 of LTR-NRC-15-7, Westinghouse stated that while the existing creep models may under predict the data under low temperature conditions, these same models provide acceptable results in the high temperature regions which is typically limiting for fuel performance analyses. Based on this information, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.8 Condition and Limitation 8

Yield Strength

The licensee shall account for the relative differences in unirradiated strength (YS [yield strength] and UTS [ultimate tensile strength]) between Optimized ZIRLO™ and standard ZIRLO™ in cladding and structural analyses until irradiated data for Optimized ZIRLO™ have been collected and provided to the NRC staff.

a. *For the Westinghouse fuel design analyses:*

   i. *The measured, unirradiated Optimized ZIRLO™ strengths shall be used for BOL [beginning-of-life] analyses.*

   ii. *Between BOL up to a radiation fluence of 3.0 x 10^{21} n/cm^2 (E>1 MeV), pseudo-irradiated Optimized ZIRLO™ strength set equal to linear interpolation between the following two strength level points: At zero fluence, strength of Optimized ZIRLO™ equal to measured strength of Optimized ZIRLO™ and at a fluence of 3.0 x 10^{21} n/cm2 (E>1 MeV), irradiated strength of standard ZIRLO™ at the fluence of 3.0 x 10^{21} n/cm^2 (E>1 MeV) minus 3 ksi.*

   iii. *During subsequent irradiation from 3.0 x 10^{21} n/cm^2 up to 12 x 10^{21} n/cm^2, the differences in strength (the difference at a fluence of 3 x 1021 n/cm2 due to tin content) shall be decreased linearly such that the pseudo-irradiated Optimized ZIRLO™ strengths will saturate at the same properties as standard ZIRLO™ at 12 x 10^{21} n/cm^2.*

b. *For the CE fuel design analyses, the measured, unirradiated Optimized ZIRLO™ strengths shall be used for all fluence levels (consistent with previously approved methods).*

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 8

Because WCNOC has stated that future analysis of Optimized ZIRLO™ will use the yield strength and ultimate tensile strength as modified per Conditions 8.a.i, 8.a.ii, and 8.a.iii until such time as the irradiated data for Optimized ZIRLO™ cladding strengths have been collected

and accepted by the NRC and that this is conformed as part of the normal reload design process, the NRC staff has concluded that this condition and limitation has been satisfied.

WCGS uses a Westinghouse fuel design, and therefore condition and limitation 8.b does not apply.

3.1.2.9 Condition and Limitation 9

LOCBART or STRIKIN-II early PCT [Peak Cladding Temperature]

As discussed in response to RAI #21 (Reference 3), for plants introducing Optimized ZIRLO™ that are licensed with LOCBART or STRIKIN-II and have a limiting PCT that occurs during blowdown or early reflood, the limiting LOCBART or STRIKIN-II calculation will be rerun using the specified Optimized ZIRLO™ material properties. Although not a condition of approval, the NRC staff strongly recommends that, for future evaluations, Westinghouse update all computer models with Optimized ZIRLO™ specific material properties.

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 9

WCGS is not licensed with LOCBART or STRIKIN-II. Therefore, the NRC staff has concluded that this condition and limitation does not apply.

3.1.2.10 Condition and Limitation 10

Locked Rotor PCT

Due to the absence of high temperature oxidation data for Optimized ZIRLO™, the Westinghouse coolability limit on PCT during the locked rotor event shall be [proprietary limits included in the topical report and proprietary version of the SE].

SE for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A
Condition and Limitation 10

Because WCNOC has confirmed that the PCT limit during the locked rotor event will be assessed relative to the Westinghouse Optimized ZIRLO™ PCT and that this is conformed as part of the normal reload design process, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.3 Thermal-Hydraulic Design, Transients and Accidents Methodology

The licensee will treat the transition to Optimized ZIRLO™ using the same thermal-hydraulic analysis and transients and accident (non-LOCA) analyses described in WCNOC Topical Reports (References 17, 18, and 19) which are listed in WCGS TS 5.6.5, "Core Operating Limits Report (COLR)." In an RAI dated April 25, 2016 (Reference 20), the NRC requested WCNOC to confirm that these methods remain valid for Optimized ZIRLO™. In its May 19, 2016, response to the RAI (Reference 2), WCNOC confirmed that its methodology is consistent with the Westinghouse modeling approach, and therefore the same conclusion applies: the transition to Optimized ZIRLO™ has no impact on both non-LOCA and LOCA analyses methodologies at WCGS.

3.1.4 Conclusion

The NRC staff concludes that the proposed changes to the TS 4.2.1 and TS 5.6.5 and the use of Optimized ZIRLO™ fuel cladding at WCGS are acceptable. The staff's conclusion is based upon its prior approval of Optimized ZIRLO™, the licensee's continued compliance with the SE conditions and limitations, and the licensee's use of approved methodologies for thermal-hydraulic, and transients and accidents analyses.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Kansas State official, Ms. K. Steves, was notified on July 5, 2016, of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves 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 amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on April 12, 2016 (81 FR 21603). Accordingly, the amendment meets 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 amendment.

6.0 CONCLUSION

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

7.0 REFERENCES

1. McCoy, J. H., Wolf Creek Nuclear Operating Corporation, letter to U.S. Nuclear Regulatory Commission, "Docket No. 50-482: Revision to Technical Specifications and 10 CFR 50.12 Exemption Request to Allow Use of Optimized ZIRLO," dated January 27, 2016 (ADAMS Accession No. ML16033A470).

2. McCoy, J. H., Wolf Creek Nuclear Operating Corporation, letter to U.S. Nuclear Regulatory Commission, "Docket No. 50-482: Response to Request for Additional Information Regarding License Amendment Request to Allow Use of Optimized ZIRLO™," dated May 19, 2016 (ADAMS Accession No. ML16161A509).

3. Westinghouse Electric Company, "Optimized ZIRLO™," WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, July 2006 (Not publicly available. Proprietary information.)

4. Westinghouse Electric Company, "VANTAGE+ Fuel Assembly Reference Core Report," WCAP-12610-P-A, April 1995 (Not publicly available. Proprietary information.)

5. Singal, B. K., U.S. Nuclear Regulatory Commission, letter to Edward D. Halpin, STP Nuclear Operating Company, "South Texas Project, Units 1 and 2 – Exemption from the Requirements of 10 CFR Section 50.46 and Appendix K to 10 CFR Part 50 to Allow the Use of Optimized ZIRLO™ as Fuel Rod Cladding Material (TAC Nos. ME5365 and ME5366)," dated October 28, 2011 (ADAMS Accession No. ML112420611).

6. Tam, P. S. , U.S. Nuclear Regulatory Commission, letter to Lawrence J. Weber, Indiana Michigan Power Company, "Donald C. Cook Nuclear Plant, Unit 2, Exemption from the Requirements of 10 CFR Section 50.46 and Appendix K to 10 CFR Part 50 to Allow the Use of Optimized ZIRLO™ Clad Fuel Rods (TAC No. ME7722)," dated August 23, 2012 (ADAMS Accession No. ML12142A287).

7. Klett, A. L., U.S. Nuclear Regulatory Commission, letter to Mano Nazar, NextEra Energy, "Turkey Point Nuclear Generating Unit Nos. 3 and 4 - Exemption from the Requirements of 10 CFR Section 50.46 and Appendix K to 10 CFR Part 50 to Allow the Use of Optimized ZIRLO™ Clad Fuel Rods (TAC Nos. MF1453 and MF1454)," dated February 20, 2014 (ADAMS Accession No. ML13329A348).

8. Beltz, T. A., U.S. Nuclear Regulatory Commission, letter to Eric McCartney, NextEra Energy Point Beach, LLC, "Point Beach Nuclear Plant, Units 1 and 2 – Exemption from the Requirements of 10 CFR Section 50.46 and Appendix K to 10 CFR Part 50 to Allow the Use of Optimized ZIRLO™ Clad Fuel Rods (TAC Nos. MF1945 and MF1946)," dated May 9, 2014 (ADAMS Accession No. ML14058B059).

9. Lamb, J. G., U.S. Nuclear Regulatory Commission, letter to Kevin Walsh, NextEra Energy Seabrook, LLC, "Seabrook Station, Unit 1, Exemption from the Requirements of 10 CFR Section 50.46 and Appendix K to 10 CFR Part 50 to Allow the Use of Optimized ZIRLO™ Clad Fuel Rods (TAC No. MF2411)," dated March 5, 2014 (ADAMS Accession No. ML13213A074).

10. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A 'Optimized ZIRLO™' (Proprietary/Non-proprietary)," LTR-NRC-07-1, dated January 4, 2007 (ADAMS Package Accession No. ML070100383).

11. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A 'Optimized ZIRLO™' (Proprietary/Non-proprietary)," LTR-NRC-07-58, dated November 6, 2007 (ADAMS Package Accession No. ML073130555).

12. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A 'Optimized ZIRLO™' (Proprietary/Non-proprietary)," LTR-NRC-07-58, Revision 1, dated February 5, 2008 (ADAMS Package Accession No. ML080390494).

13. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A 'Optimized ZIRLO™' (Proprietary/Non-proprietary)," LTR-NRC-08-60, dated December 30, 2008 (ADAMS Package Accession No. ML090080384).

14. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A 'Optimized ZIRLO™' (Proprietary/Non-proprietary)," LTR-NRC-10-53, dated July 26, 2010 (ADAMS Package Accession No. ML102140223).

15. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A 'Optimized ZIRLO™' (Proprietary/Non-proprietary)," LTR-NRC-13-6, dated February 25, 2013 (ADAMS Package Accession No. ML130700206).

16. Gresham, J. A., Westinghouse Electric Company, LLC, letter to U.S. Nuclear Regulatory Commission, "Submittal of Responses to Draft RAIs and Revisions to Select Figures in LTR-NRC-13-6 to Fulfill Conditions 6 and 7 of the Safety Evaluation for WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A (Proprietary/Non-Proprietary)," LTR-NRC-15-7, dated February 9, 2015 (ADAMS Package Accession No. ML15051A405).

17. Rhodes, F. T., Wolf Creek Nuclear Operating Corporation, letter to U.S. Nuclear Regulatory Commission, "Core Thermal-Hydraulics Analysis Methodology for the Wolf Creek Generating Station," dated August 21, 1990 (ADAMS Accession No. ML16161A505). Letter transmits TR-90-0025, "Core Thermal-Hydraulics Analysis Methodology for the Wolf Creek Generating Station," July 1990 (Not publicly available. Proprietary information.)

18. Rhodes, F. T., Wolf Creek Nuclear Operating Corporation, letter to U.S. Nuclear Regulatory Commission, "Docket No. 50-482: WCNOC Transient Analysis Methodology Topical," dated February 1, 1991 (ADAMS Accession No. ML16161A506). Letter transmits of Volumes 1 and 2 of NASG-006, Revision 1, "Transient Analysis Methodology for the Wolf Creek Generating Station," January 1995 (Not publicly available. Proprietary information.)

19. Rhodes, F. T., Wolf Creek Nuclear Operating Corporation, letter to U.S. Nuclear Regulatory Commission, "Docket No. 50-482: Reload Safety Evaluation Methodology Topical Report," dated March 11, 1992 (ADAMS Accession No. ML16161A507). Letter transmits NASG-007, Revision 0, "Reload Safety Evaluation Methodology for the Wolf Creek Generating Station," January 1992 (Not publicly available. Proprietary information).

20. Lyon, C. F., U.S. Nuclear Regulatory Commission, letter to Adam C. Heflin, Wolf Creek Nuclear Operating Corporation, "Wolf Creek Generating Station – Request for Additional Information RE: License Amendment Request to Allow Use of Optimized ZIRLO™ (CAC No. MF7285)," dated April 25, 2016 (ADAMS Accession No. ML16110A372).

Principal Contributor: J. Kaizer, NRR/DSS/SNPB

Date: August 3, 2016

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

Sincerely,

/RA/

Carl F. Lyon, Project Manager
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosures:
1. Amendment No. 216 to NPF-42
2. Safety Evaluation

cc w/encls: Distribution via Listserv

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JKaizer, NRR/DSS/SNPB

ADAMS Accession No. ML16179A293 ***via memo dated**

OFFICE	NRR/DORL/LPL4-1/PM	NRR/DORL/LPL4-1/LA	NRR/DSS/STSB/BC	NRR/DSS/SNPB/BC
NAME	FLyon	JBurkhardt	AKlein	JDean*
DATE	7/5/16	6/29/16	7/6/16	6/22/16
OFFICE	OGC – NLO	NRR/DORL/LPL4-1/BC	NRR/DORL/LPL4-1/PM	
NAME	DRoth	RPascarelli	FLyon	
DATE	7/26/16	8/2/16	8/3/16	

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