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

July 25, 2019

Mr. Joseph W. Shea
Vice President, Nuclear Regulatory Affairs
and Support Services
Tennessee Valley Authority
1101 Market Street, LP 4A
Chattanooga, TN 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2 – ISSUANCE OF AMENDMENT NOS. 127 AND 30 REGARDING THE USE OF OPTIMIZED ZIRLO™ FUEL ROD CLADDING (EPID L-2018-LLA-0197)

Dear Mr. Shea:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment Nos. 127 and 30 to Facility Operating License Nos. NPF-90 and NPF-96 for the Watts Bar Nuclear Plant (Watts Bar), Units 1 and 2, respectively. These amendments are in response to your application dated July 23, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18205A492).

The amendments revise Watts Bar, Units 1 and 2, Technical Specifications 4.2.1, "Fuel Assemblies," and 5.9.5, "Core Operating Limits Report (COLR)," to allow the use of Optimized ZIRLO™ fuel rod cladding material. In the letter dated July 23, 2018, the licensee also requested an exemption in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.12, "Specific exemptions," from certain requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS [emergency core cooling system] Evaluation Models." The requested exemption is addressed in separate correspondence (ADAMS Accession No. ML19112A011).

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

Sincerely,

For

Michael J. Wentzel, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-390 and 50-391

Enclosures:
1. Amendment No. 127 to NPF-90
2. Amendment No. 30 to NPF-96
3. Safety Evaluation

cc: Listserv

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-390

WATTS BAR NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 127
License No. NPF-90

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

   A. The application for amendment by Tennessee Valley Authority (TVA, the licensee) dated July 23, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-90 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. 127 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

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

FOR THE NUCLEAR REGULATORY COMMISSION

Undine Shoop, Chief
Plant Licensing Branch II-2
Division of operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License
and Technical Specifications

Date of Issuance: July 25, 2019

ATTACHMENT TO AMENDMENT NO. 127

WATTS BAR NUCLEAR PLANT, UNIT 1

FACILITY OPERATING LICENSE NO. NPF-90

DOCKET NO. 50-390

Replace page 3 of Facility Operating License No. NPF-90 with the attached revised page 3.

Replace the following pages of the Appendix A Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

Remove Pages	Insert Pages
4.0-1	4.0-1
5.0-30	5.0-30

(4) TVA, 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, instrument calibration, or other activity associated with radioactive apparatus or components; and

(5) TVA, 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 license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect, and is subject to the additional conditions specified or incorporated below.

(1) Maximum Power Level

TVA is authorized to operate the facility at reactor core power levels not in excess of 3459 megawatts thermal.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A as revised through Amendment No. 127 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) Safety Parameter Display System (SPDS) (Section 18.2 of SER Supplements 5 and 15)

Prior to startup following the first refueling outage, TVA shall accomplish the necessary activities, provide acceptable responses, and implement all proposed corrective actions related to having the Watts Bar, Unit 1 SPDS operational.

(4) Vehicle Bomb Control Program (Section 13.6.9 of SSER 20)

During the period of the exemption granted in paragraph 2.D.(3) of this license, in implementing the power ascension phase of the approved initial test program, TVA shall not exceed 50% power until the requirements of 10 CFR 73.55(c)(7) and (8) are fully implemented. TVA shall submit a letter under oath or affirmation when the requirements of 73.55(c)(7) and (8) have been fully implemented.

4.0 DESIGN FEATURES

4.1 Site

4.1.1 Site and Exclusion Area Boundaries

The site and exclusion area boundaries shall be as shown in Figure 4.1-1.

4.1.2 Low Population Zone (LPZ)

The LPZ shall be as shown in Figure 4.1-2 (within the 3-mile circle).

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. For Unit 1 Watts Bar is authorized to place a maximum of 1792 Tritium Producing Burnable Absorber Rods into the reactor in an operating cycle.

4.2.2 Control Rod Assemblies

The reactor core shall contain 57 control rod assemblies. The control material shall be either silver-indium-cadmium or boron carbide with silver indium cadmium tips as approved by the NRC.

(continued)

5.9 Reporting Requirements

5.9.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

3. WCAP-10216-P-A, Revision 1A, "RELAXATION OF CONSTANT AXIAL OFFSET CONTROL F(Q) SURVEILLANCE TECHNICAL SPECIFICATION," February 1994 (W Proprietary). (Methodology for Specifications 3.2.1 - Heat Flux Hot Channel Factor (W(Z) Surveillance Requirements For F(Q) Methodology) and 3.2.3 - Axial Flux Difference (Relaxed Axial Offset Control).)

4. WCAP-12610-P-A, "VANTAGE + FUEL ASSEMBLY REFERENCE CORE REPORT," April 1995. (W Proprietary). (Methodology for Specification 3.2.1 - Heat Flux Hot Channel Factor).

5. WCAP-15088-P, Rev. 1, "Safety Evaluation Supporting A More Negative EOL Moderator Temperature Coefficient Technical Specification for the Watts Bar Nuclear Plant," July 1999, (W Proprietary), as approved by the NRC staff's Safety Evaluation accompanying the issuance of Amendment No. 20 (Methodology for Specification 3.1.4 - Moderator Temperature Coefficient.).

6. Caldon, Inc. Engineering Report-80P, "Improving Thermal Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM✓™ System," Revision 0, March 1997; and Caldon, Inc. Engineering Report-160P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate With the LEFM✓™," Revision 0, May 2000; as approved by the NRC staff's Safety Evaluation accompanying the issuance of Amendment No. 31.

7. WCAP-11397-P-A, "Revised Thermal Design Procedure," April 1989. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

8. WCAP-15025-P-A, "Modified WRB-2 Correlation, WRB-2M, for Predicting Critical Heat Flux in 17 x 17 Rod Bundles with Modified LPD Mixing Vane Grids," April 1999. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

9. WCAP-14565-P-A, "VIPRE-01 Modeling and Qualification for Pressurized Water Reactor Non-LOCA Thermal-Hydraulic Safety Analysis," October 1999. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

10. WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™."

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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WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-391

WATTS BAR NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 30
License No. NPF-96

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

   A. The application for amendment by Tennessee Valley Authority (TVA, the licensee) dated July 23, 2018, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, Facility Operating License No. NPF-96 is amended as indicated in the attachment to this license amendment, and paragraph 2.C.(2) 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. 30 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

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

FOR THE NUCLEAR REGULATORY COMMISSION

Undine Shoop, Chief
Plant Licensing Branch II-2
Division of operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License
and Technical Specifications

Date of Issuance: July 25, 2019

ATTACHMENT TO AMENDMENT NO. 30

WATTS BAR NUCLEAR PLANT, UNIT 2

FACILITY OPERATING LICENSE NO. NPF-96

DOCKET NO. 50-391

Replace page 3 of Facility Operating License No. NPF-96 with the attached revised page 3.

Replace the following pages of the Appendix A Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

Remove Pages	Insert Pages
4.0-1	4.0-1
5.0-32	5.0-32

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

(1) Maximum Power Level

TVA is authorized to operate the facility at reactor core power levels not in excess of 3411 megawatts thermal.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A as revised through Amendment No. 30 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) TVA shall implement permanent modifications to prevent overtopping of the embankments of the Fort Loudon Dam due to the Probable Maximum Flood by June 30, 2018.

(4) PAD4TCD may be used to establish core operating limits for Cycles 1 and 2 only. PAC4TCD may not be used to establish core operating limits for subsequent reload cycles.

(5) By December 31, 2019, the licensee shall report to the NRC that the actions to resolve the issues identified in Bulletin 2012-01, "Design Vulnerability in Electrical Power System," have been implemented.

(6) The licensee shall maintain in effect the provisions of the physical security plan, security personnel training and qualification plan, and safeguards contingency plan, and all amendments made pursuant to the authority of 10 CFR 50.90 and 50.54(p).

(7) TVA shall fully implement and maintain in effect all provisions of the Commission approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The TVA approved CSP was discussed in NUREG-0847, Supplement 28, as amended by changes approved in License Amendment No. 7.

(8) TVA shall implement and maintain in effect all provisions of the approved fire protection program as described in the Fire Protection Report for the facility, as described in NUREG-0847, Supplement 29, subject to the following provision:

4.0 DESIGN FEATURES

4.1 Site

4.1.1 Site and Exclusion Area Boundaries

The site and exclusion area boundaries shall be as shown in Figure 4.1-1.

4.1.2 Low Population Zone (LPZ)

The LPZ shall be as shown in Figure 4.1-2 (within the 3-mile circle).

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of 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 57 control rod assemblies. The control material shall be silver indium cadmium as approved by the NRC.

(continued)

5.9 Reporting Requirements

5.9.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

5. WCAP-15088-P, Rev. 1, "Safety Evaluation Supporting A More Negative EOL Moderator Temperature Coefficient Technical Specification for the Watts Bar Nuclear Plant," July 1999, (W Proprietary), as approved by the NRC staff's Safety Evaluation accompanying the issuance of Amendment No. 20 (Methodology for Specification 3.1.4 - Moderator Temperature Coefficient.).

6. WCAP-11397-P-A, "Revised Thermal Design Procedure," April 1989. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

7. WCAP-15025-P-A, "Modified WRB-2 Correlation, WRB-2M, for Predicting Critical Heat Flux in 17 x 17 Rod Bundles with Modified LPD Mixing Vane Grids," April 1999. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

8. WCAP-14565-P-A, "VIPRE-01 Modeling and Qualification for Pressurized Water Reactor Non-LOCA Thermal-Hydraulic Safety Analysis," October 1999. (Methodology for Specification 3.2.2 - Nuclear Enthalpy Rise Hot Channel Factor).

9a. WCAP-12472-P-A, "BEACON™ CORE MONITORING AND OPERATIONS SUPPORT SYSTEM," August 1994, (W Proprietary). (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

9b. WCAP-12472-P-A, Addendum 1-A, "BEACON™ MONITORING AND OPERATIONS SUPPORT SYSTEM," January 2000, (W Proprietary). (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

9c. WCAP-12472-P-A, Addendum 2-A, "BEACON™ MONITORING AND OPERATIONS SUPPORT SYSTEM (WCAP-12472-P-A) Addendum 2," April 2002, (W Proprietary) (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

9d. WCAP-12472-P-A, Addendum 4, "BEACON™ CORE MONITORING AND OPERATIONS SUPPORT SYSTEM, Addendum 4," September 2012, (W Proprietary) (Methodology for Specification 3.2.1 – Heat Flux Hot Channel Factor, and 3.2.2 – Nuclear Enthalpy Rise Hot Channel Factor).

10 WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™."

(continued)

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 127 AND 30 TO

TENNESSEE VALLEY AUTHORITY

AMENDMENTS TO FACILITY OPERATING LICENSE NOS. NPF-90 AND NPF-96

WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-390 AND 50-391

1.0 INTRODUCTION

By letter dated July 23, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18205A492), Tennessee Valley Authority (TVA or the licensee) submitted a license amendment request (LAR) for Watts Bar Nuclear Plant (Watts Bar), Units 1 and 2. The proposed amendments would revise Technical Specification (TS) 4.2.1, "Fuel Assemblies," and TS 5.9.5, "Core Operating Limits Report (COLR)," to allow the use of Optimized ZIRLO™ [1] fuel cladding material in both Watts Bar, Units 1 and 2. In order to support the TS change, and pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.12, "Specific exemptions," TVA also requested an exemption from certain requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems [ECCSs] for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models" for Watts Bar, Units 1 and 2. The exemption request relates solely to the specific type of cladding material described in these regulations for use in light-water reactors, namely ZIRLO™ and Zircaloy-4. The requested exemption is addressed in separate correspondence (ADAMS Accession No. ML19112A011).

The licensee plans to use Optimized ZIRLO™ fuel cladding for the core reload scheduled for the Watts Bar, Unit 2 Fall 2020 Refueling Outage and the Watts Bar, Unit 1, Fall 2021 Refueling Outage.

2.0 REGULATORY EVALUATION

The U.S. Nuclear Regulatory Commission (NRC or the Commission) staff considered the following regulatory requirements, guidance, and licensing and design-basis information during its review of the proposed changes.

2.1 Regulatory Requirements and Guidance

As part of this LAR, the licensee requested a revision to TSs 4.2.1 and 5.9.5 to allow the use of Optimized ZIRLO™ fuel cladding material in Watts Bar, Units 1 and 2. The Optimized ZIRLO™

[1] Optimized ZIRLO is a trademark of Westinghouse Electric Company LLC.

fuel cladding is different from standard ZIRLO™ in two respects: (1) the tin content is lower; and (2) the microstructure is different. The difference in tin content and microstructure can lead to differences in some material properties.

The NRC's regulatory requirements related to the content of the TSs are set forth in 10 CFR 50.36, "Technical specifications." This regulation requires that TSs 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.

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, in part, to the NRC staff for the review of fuel rod cladding materials and fuel system. 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.

Appendix K, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 (hereinafter referred to as GDC), establishes the minimum requirements for the principal design criteria for water-cooled nuclear power plants. The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety.

As stated in the Watts Bar Updated Final Safety Analysis Report (UFSAR), Section 3.1.1, "Introduction," Watts Bar was designed to meet the intent of the "Proposed General Design Criteria for Nuclear Power Plant Construction Permits" published in July 1967. The Watts Bar construction permit was issued in January 1973. The Watts Bar UFSAR, however, addresses the NRC GDC published as Appendix A to 10 CFR Part 50 in July 1971, including Criterion 4 as amended October 27, 1987.

The Watts Bar UFSAR provides a discussion of the design features and procedures that meet the intent of the design criteria, including a discussion of any exceptions to the GDC. The GDC that are relevant to this LAR are described in the Watts Bar UFSAR as follows.

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."
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."

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."

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available), the system safety function can be accomplished, assuming a single failure.

Pursuant to 10 CFR 50.12, "Specific exemptions," TVA has requested an exemption to 10 CFR 50.46, "Acceptance criteria for ECCSs for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models." The regulation in 10 CFR 50.46 contains acceptance criteria for ECCS for reactors fueled with Zircaloy or ZIRLO™ cladding. In addition, 10 CFR Part 50, Appendix K, requires that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction.

The exemption request relates solely to the specific types of cladding material specified in these regulations. Currently, the TSs specify that each assembly in Unit 1 shall consist of a matrix of ZIRLO™ fuel rods, and each assembly in Unit 2 shall consist of a matrix of Zircaloy or ZIRLO™ fuel rods. As written, the regulations presume the use of either Zircaloy or ZIRLO™ fuel rod cladding. Thus, an exemption from the requirements of 10 CFR 50.46 and 10 CFR Part 50, Appendix K, is needed to apply the acceptance criteria to a cladding alloy other than Zircaloy or ZIRLO™. The proposed change to TS 4.2.1 adds Optimized ZIRLO™ to the list of approved fuel rod cladding material. The NRC staff has previously reviewed and approved Optimized ZIRLO™ cladding material for application in Westinghouse and Combustion Engineering fuel assembly designs (ADAMS Accession No. ML051670403).

3.0 TECHNICAL EVALUATION

3.1 Proposed Change to TS 4.2.1 and TS 5.9.5

3.1.1 Introduction

The proposed change (ADAMS Accession No. ML18205A492) to the Watts Bar TS, adds "Optimized ZIRLO™" to the list of approved fuel rod cladding materials in the TS 4.2.1, "Fuel Assemblies," and revises TS 5.9.5, "Core Operating Limits Report" to add NRC-approved Topical Report WCAP-12610-P-A and CENPD-04-P-A, Addendum 1-A, "Optimized ZIRLO™" (ADAMS Accession No. ML062080569), to the list of analytical methods. In addition, the proposed change to TS 4.2.1 includes editorial changes, correction of the spelling of the word Zircaloy, addition of the word "clad" after the phrase "Optimized ZIRLO™," and addition of registered trademark designator to the word ZIRLO™. These changes are editorial in nature and do not change or impact the methodology.

Additionally, in order to use Optimized ZIRLO™ fuel rod cladding material in future core reloads at Watts Bar, TVA, pursuant to 10 CFR 50.12, requested an exemption (ADAMS Accession No. ML19112A011) from the requirements of 10 CFR Section 50.46 and 10 CFR Part 50, Appendix K, for Watts Bar, Units 1 and 2.

3.1.2 Technical Evaluation

The NRC staff's safety evaluation (SE) for the topical report on Optimized ZIRLO™ (ADAMS Accession No. ML051670408) includes ten conditions and limitations. The licensee has documented compliance with these ten conditions and limitations in the technical evaluation Section 3.0 of the LAR. Adding the topical report to the COLR will ensure compliance for future reloads. TVA's response to the ten conditions in the NRC staff's SE for Optimized ZIRLO™ are addressed below. The language in italics is taken from the SE referenced above.

3.1.2.1 NRC Condition and Limitation 1 for Optimized ZIRLO™

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.

Watts Bar has submitted a request for the required exemption from 10 CFR 50.46 and 10 CFR Part 50, Appendix K, in Enclosure 2 of the LAR. The NRC staff concludes that TVA's submittal, requesting an exemption from the above requirements, satisfies this condition and limitation.

3.1.2.2 NRC Condition and Limitation 2 for Optimized ZIRLO™

Burnup Limit

The fuel rod burnup limit for this approval remains at currently established limits of 62 gigawatt days per metric tonne of uranium (GWd/MTU) for Westinghouse fuel designs and 60 GWd/MTU for Combustion Engineering (CE) fuel designs.

Watts Bar, Units 1 and 2, use a Westinghouse fuel design, and TVA has specified that Watts Bar will continue to use a 62 GWd/MTU rod burnup limit until such time that a new fuel rod burnup limit is approved for use by the NRC. TVA specified, in the LAR, that it will confirm the fuel burnup limit as part of the normal reload design process. The NRC staff concludes that since Watts Bar has specified that it will continue using a 62 GWd/MTU rod burnup limit until a new fuel rod burnup limit is approved for use by the NRC and will confirm the fuel burnup limit as part of the normal reload design process, this condition and limitation has been satisfied.

3.1.2.3 NRC Condition and Limitation 3 for Optimized ZIRLO™

Corrosion Limit

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

TVA has confirmed that the maximum fuel rod waterside corrosion limit for fuel using Optimized ZIRLO™ cladding will be certified to be less than the specified proprietary limits for all fuel rod locations as part of the normal reload design process. As a result of this confirmation, the NRC staff concludes that this condition and limitation has been satisfied.

3.1.2.4 NRC Condition and Limitation 4 for Optimized ZIRLO™

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.

TVA specified, in the LAR, that future Optimized ZIRLO™ fuel rod analysis will continue to meet all conditions associated with approved methods. Furthermore, the licensee specified that confirmation of these conditions is required as part of the normal reload design process. Since TVA has specified that future Optimized ZIRLO™ fuel rod analysis will continue to meet all conditions associated with approved methods, the NRC staff concludes that this condition and limitation has been satisfied.

3.1.2.5 NRC Condition and Limitation 5 for Optimized ZIRLO™

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 [WCAP-12610-P-A and CENPD-404-P-A] Addendum 1 and responses to requests for additional information (RAIs) were performed.

TVA 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 this condition is part of the normal reload design process. Since TVA 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, as part of the normal reload design process, the NRC staff concludes that this condition and limitation has been satisfied.

3.1.2.6 NRC Condition and Limitation 6 for Optimized ZIRLO™

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™ lead test assembly (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.

Westinghouse has provided the NRC staff with information related to test data and models. As a result, the NRC staff has confirmed that this condition has been satisfied as specified in the NRC staff's evaluation of the Westinghouse Topical Report (ADAMS Accession No. ML16173A354). No further information is necessary in response to this condition.

3.1.2.7 NRC Condition and Limitation 7 for Optimized ZIRLO™

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.

Westinghouse has provided the NRC with information related to test data and models. As a result, the NRC has confirmed that this condition has been satisfied as specified in the NRC staff's evaluation of the Westinghouse Topical Report (ADAMS Accession No. ML16173A354).

3.1.2.8 NRC Condition and Limitation 8 for Optimized ZIRLO™

Yield Strength

The licensee shall account for the relative differences in unirradiated 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/cm^2 (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 x10^{21} n/cm^2 due to tin content) shall be decreased linearly such that the pseudoirradiated 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).*

TVA has specified, in the LAR, that future fuel rod 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 fuel data for Optimized ZIRLO™ cladding strengths have been collected and accepted by the NRC and that this is confirmed as part of the normal reload design process. As a result, the NRC staff has concluded that this condition and limitation has been satisfied.

Watts Bar, Units 1 and 2, use a Westinghouse fuel design, and therefore, condition and limitation 8.b does not apply. Based on this information, the NRC staff has concluded that this condition and limitation has been satisfied.

3.1.2.9 NRC Condition and Limitation 9 for Optimized ZIRLO™

LOCBART or STRIKIN-II Early Peak Cladding Temperature

As discussed in response to RAI #21 (ADAMS Accession No. ML051670403), for plants introducing Optimized ZIRLO™ that are licensed with LOCBART or STRIKIN-II and have a limiting peak cladding temperature (PCT) that occurs during blowdown or early reflood, the limiting LOCBART or STRIKIN-11 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.

Watts Bar, Units 1 and 2, are not licensed to use either LOCBART or STRIKIN-11 codes. Therefore, the NRC staff concludes that this condition and limitation does not apply.

3.1.2.10 NRC Condition and Limitation 10 for Optimized ZIRLO™

Locked Rotor PCT

[As specified in WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A (ADAMS Accession No. ML062080569),] 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 topical report and proprietary version of safety evaluation].

Since TVA has confirmed that the peak cladding temperature (PCT) limit during the locked rotor event will be assessed relative to the Westinghouse Optimized ZIRLO™ cladding PCT temperature and that this is confirmed as part of the normal reload design process, the NRC staff has concluded that this condition and limitation has been satisfied.

3.2 Technical Conclusion

The NRC staff reviewed the requested editorial changes, as explained above, regarding the licensee's proposed revision to TS 4.2.1 to add Optimized ZIRLO™ to the approved fuel rod cladding materials, and the change to TS 5.9.5 to add NRC-approved Topical Report WCAP-12610-P-A and CENPD-04-P-A, Addendum 1-A to the list of analytical methods. The staff determined that the proposed changes meet the regulatory requirements of 10 CFR 50.36, as referenced in Section 2 of this SE. The staff also determined that the proposed changes will have no impact on the Watts Bar design basis, and the NRC GDC published as Appendix A to 10 CFR Part 50 in July 1971, including Criterion 4, as amended October 27, 1987, will continue to be met. Therefore, the proposed amendments to revise TSs 4.2.1 and 5.9.5 are acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendments on May 20, 2019. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change 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 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 previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on November 6, 2018 (83 FR 55576). 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.

Principal Contributors: T. Brimfield
J. Kaizer

Date: July 25, 2019

SUBJECT: WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2 – ISSUANCE OF AMENDMENT NOS. 127 AND 30 REGARDING THE USE OF OPTIMIZED ZIRLO™ FUEL ROD CLADDING (EPID L-2018-LLA-0197) DATED JULY 25, 2019

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ADAMS Accession No: ML19112A004 *by memo **by e-mail

OFFICE	DORL/LPL2/PM	DORL/LPL2/LA	DSS/SRXB/BC*	DSS/STSB/(A)BC**	DMLR/MVIB/BC**
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DATE	5/21/2019	5/30/2019; 7/24/2019	10/5/2018	5/23/2019	5/22/2019
OFFICE	DSS/SNPB/BC*	OGC – NLO**	DORL/LPL2/BC	DORL/LPL2/PM	
NAME	RLukes	KGamin	UShoop	MWentzel (NJordan for)	
DATE	10/5/2018	6/20/2019	7/25/2019	7/25/2019	

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