



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

August 2, 2016

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

SUBJECT: WOLF CREEK GENERATING STATION – EXEMPTION FROM THE
REQUIREMENTS OF 10 CFR SECTION 50.46 AND APPENDIX K OF
10 CFR PART 50 TO ALLOW THE USE OF OPTIMIZED ZIRLO™ CLAD FUEL
RODS (CAC NO. MF7286)

Dear Mr. Heflin:

The U.S. Nuclear Regulatory Commission (NRC) has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 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," for Wolf Creek Generating Station. This action is 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 NRC staff addressed the amendment request via separate correspondence.

A copy of the exemption is enclosed. The exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

A handwritten signature in black ink that reads "CF Lyon".

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

Docket No. 50-482

Enclosure
Exemption

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ENCLOSURE

FEDERAL REGISTER NOTICE

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50-482; NRC-2016-XXXX]

Wolf Creek Generating Station; Use of Optimized ZIRLO™ Fuel Rod Cladding Material

AGENCY: Nuclear Regulatory Commission.

ACTION: Exemption; issuance.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a January 27, 2016, request, as supplemented on May 19, 2016, from Wolf Creek Nuclear Operating Corporation (WCNOC or the licensee) in order to use Optimized ZIRLO™ fuel rod cladding material at Wolf Creek Generating Station (WCGS).

DATES: The exemption was issued on August 2, 2016.

ADDRESSES: Please refer to Docket ID NRC-2016-XXXX when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web Site:** Go to <http://www.regulations.gov> and search for Docket ID NRC-2016-XXXX. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **NRC's Agencywide Documents Access and Management System (ADAMS):**
You may obtain publicly-available documents online in the ADAMS Public Documents collection

at <http://www.nrc.gov/reading-rm/adams.html>. To begin the search, select “[ADAMS Public Documents](#)” and then select “[Begin Web-based ADAMS Search](#).” For problems with ADAMS, please contact the NRC’s Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr.resource@nrc.gov. The ADAMS accession number for each document referenced in this document (if that document is available in ADAMS) is provided the first time that a document is referenced.

- **NRC’s PDR:** You may examine and purchase copies of public documents at the NRC’s PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: Carl F. Lyon, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone 301-415-2296, e-mail: Fred.Lyon@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Background

The licensee is the holder of Renewed Facility Operating License No. NPF-42, which authorizes operation of WCGS. The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the NRC now or hereafter in effect. The facility consists of a pressurized-water reactor located in Coffey County, Kansas.

II. Request/Action

Pursuant to § 50.12 of title 10 of the *Code of Federal Regulations* (10 CFR), "Specific exemptions," the licensee requested by letter dated January 27, 2016, as supplemented by letter dated May 19, 2016 (ADAMS Accession Nos. ML16033A470 and ML16161A509, respectively), 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 10 CFR part 50, appendix K, "ECCS Evaluation Models," to allow the use of fuel rod cladding with Optimized ZIRLO™ alloy for future reload applications. The regulations in 10 CFR 50.46 contain acceptance criteria for the ECCS for reactors fueled with zircaloy or ZIRLO™ fuel rod cladding material. 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 Baker-Just equation assumes the use of a zirconium alloy, which is a material different from Optimized ZIRLO™. The licensee requested the exemption because these regulations do not have provisions for the use of fuel rod cladding material other than zircaloy or ZIRLO™. Because the material specifications of Optimized ZIRLO™ differ from the specifications for zircaloy or ZIRLO™, a plant-specific exemption is required to support the reload applications for WCGS.

The exemption request relates solely to the cladding material specified in these regulations (i.e., fuel rods with Zircaloy or ZIRLO™ cladding material). This exemption would provide for the application of the acceptance criteria of 10 CFR 50.46 and 10 CFR part 50, appendix K, to fuel assembly designs using Optimized ZIRLO™ fuel rod cladding material. In its letter dated January 27, 2016, as supplemented by letter dated May 19, 2016, the licensee indicated that it was not seeking an exemption from the acceptance and analytical criteria of

these regulations. The intent of the request is to allow the use of the criteria set forth in these regulations for application of the Optimized ZIRLO™ fuel rod cladding material.

III. Discussion

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50 when: (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. Under 10 CFR 50.12(a)(2), special circumstances include, among other things, when application of the specific regulation in the particular circumstance would not serve, or is not necessary to achieve, the underlying purpose of the rule.

A. Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.46 and 10 CFR part 50, appendix K, is to establish acceptance criteria for ECCS performance. The regulations in 10 CFR 50.46 and 10 CFR part 50, appendix K, are not directly applicable to Optimized ZIRLO™, even though the evaluations described in the following sections of this exemption show that the intent of the regulation is met. Therefore, since the underlying purposes of 10 CFR 50.46 and 10 CFR part 50, appendix K, are achieved through the use of Optimized ZIRLO™ fuel rod cladding material, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption exist.

B. Authorized by Law

This exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material for future reload applications at WCGS. As stated above, 10 CFR 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR part 50. The NRC staff has determined that granting the licensee's proposed exemption would not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations. Therefore, the exemption is authorized by law.

C. No Undue Risk to Public Health and Safety

Section 50.46 requires that each boiling or pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical zircaloy or ZIRLO™ cladding must be provided with an ECCS that must be designed so that its calculated cooling performance following postulated loss-of-coolant accidents (LOCAs) conforms to the criteria set forth in 10 CFR 50.46(b). The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for adequate ECCS performance. As previously documented in the NRC staff's safety evaluation dated June 10, 2005 (ADAMS Package Accession No. ML051670395), of topical reports submitted by Westinghouse Electric Company (Westinghouse), and subject to compliance with the specific conditions of approval established in the safety evaluation, the NRC staff found that Westinghouse demonstrated the applicability of these ECCS acceptance criteria to Optimized ZIRLO™. The NRC staff found that the Westinghouse topical report demonstrates the applicability of these ECCS acceptance criteria to Optimized ZIRLO™, subject to the compliance with the specific conditions of approval established therein. The NRC staff reviewed the licensee's January 27, 2016, application, as supplemented by letter dated May 9, 2016, against these specific conditions and found that the licensee was in compliance with all of the applicable conditions. The NRC staff's review of these specific conditions for WCGS can be

found in ADAMS under Accession No. ML16179A293. Ring compression tests performed by Westinghouse on Optimized ZIRLO™ (see WCAP-14342-A & CENPD-404-NP-A, dated July 2006 (ADAMS Accession No. ML062080569), demonstrate an acceptable retention of post-quench ductility up to 10 CFR 50.46 limits of 2200 degrees Fahrenheit and 17 percent equivalent clad reacted. Furthermore, the NRC staff concluded that oxidation measurements provided by the licensee by letter LTR-NRC-07-58 from Westinghouse to the NRC, "SER Compliance with WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A, 'Optimized ZIRLO™,'" dated November 6, 2007 (public version in ADAMS under Accession No. ML073130560), illustrate that oxide thickness and associated hydrogen pickup for Optimized ZIRLO™ at any given burnup would be less than both zircaloy-4 and ZIRLO™. Hence, the NRC staff concludes that Optimized ZIRLO™ would be expected to maintain better post-quench ductility than ZIRLO™. This finding is further supported by an ongoing LOCA research program at Argonne National Laboratory, which has identified a strong correlation between cladding hydrogen content (caused by in-service corrosion) and post-quench ductility.

In addition, the provisions of 10 CFR 50.46 require the licensee to periodically evaluate the performance of the ECCS, using currently approved LOCA models and methods, to ensure that the fuel rods will continue to satisfy the 10 CFR 50.46 acceptance criteria. In its letter dated January 27, 2016, the licensee stated that for LOCA scenarios, where the slight difference in Optimized ZIRLO™ material properties relative to standard ZIRLO™ could have some impact on the overall accident scenario, plant-specific LOCA analyses using Optimized ZIRLO™ properties will demonstrate that the acceptance criteria of 10 CFR 50.46 have been satisfied. Granting the exemption to allow the licensee to use Optimized ZIRLO™ fuel rod cladding material in addition to the current mix of fuel rods does not diminish this requirement of periodic evaluation of ECCS performance. Therefore, the underlying purpose of the rule will continue to be achieved for WCGS.

Paragraph I.A.5 of 10 CFR part 50, appendix K, states that the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. Since the Baker-Just equation presumes the use of zircaloy clad fuel, strict application of this provision of the rule would not permit use of the equation for the Optimized ZIRLO™ fuel rod cladding material for determining acceptable fuel performance. However, the NRC staff previously found that metal-water reaction tests performed by Westinghouse on Optimized ZIRLO™ (see Appendix B of WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A) demonstrate conservative reaction rates relative to the Baker-Just equation. Therefore, the NRC staff determined that the application of Paragraph I.A.5 of 10 CFR part 50, appendix K, is not necessary to achieve the underlying purpose of the rule in these circumstances. Since these evaluations demonstrate that the underlying purpose of the rule will be met, there will be no undue risk to the public health and safety.

D. Consistent with the Common Defense and Security

The licensee's exemption request is only to allow the application of the aforementioned regulations to an improved fuel rod cladding material. In its letter dated January 27, 2016, as supplemented by letter dated May 19, 2016, the licensee stated that all the requirements and acceptance criteria will be maintained. The licensee is required to handle and control special nuclear material in these assemblies in accordance with its approved procedures. This change to the plant configuration is not related to security issues. Therefore, the NRC staff determined that this exemption does not impact common defense and security.

E. Environmental Considerations

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9) because it is related to a

requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR part 20, and the granting of this exemption involves: (i) no significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's consideration of this exemption request. The basis for the NRC staff's determination is discussed as follows with an evaluation against each of the requirements in 10 CFR 51.22(c)(9).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC staff evaluated the issue of no significant hazards consideration, using the standards described in 10 CFR 50.92(c), as presented below:

1. Does the proposed exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No. The proposed change would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. The NRC approved topical report WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A, "Optimized ZIRLO™," prepared by Westinghouse, addresses Optimized ZIRLO™ and demonstrates that Optimized ZIRLO™ has essentially the same properties as the currently licensed ZIRLO™. The fuel cladding itself is not an accident initiator and does not affect accident probability. Use of Optimized ZIRLO™ fuel rod cladding material will continue to meet all 10 CFR 50.46 acceptance criteria and, therefore, will not increase the consequences of an accident.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed exemption create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No. The use of Optimized ZIRLO™ fuel rod cladding material will not result in changes in the operation or configuration of the facility. Topical Report WCAP-12610-P-A & CENPD-404-P-A demonstrated that the material properties of Optimized ZIRLO™ are similar to those of standard ZIRLO™. Therefore, the Optimized ZIRLO™ fuel rod cladding material will perform similarly to those fabricated from standard ZIRLO™, therefore precluding the possibility of the fuel cladding becoming an accident initiator and causing a new or different type of accident.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed exemption involve a significant reduction in a margin of safety?

Response: No. The proposed change will not involve a significant reduction in the margin of safety, because it has been demonstrated that the material properties of the Optimized ZIRLO™ are not significantly different from those of standard ZIRLO™. Optimized ZIRLO™ is expected to perform similarly to standard ZIRLO™ for all normal operating and accident scenarios, including both LOCA and non-LOCA scenarios. For LOCA scenarios, where the slight difference in the Optimized ZIRLO™ material properties, relative to standard ZIRLO™ could have some impact on the overall accident scenario, plant-specific LOCA analyses using the Optimized ZIRLO™ properties demonstrate that the acceptance criteria of 10 CFR 50.46 have been satisfied.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, the NRC staff concludes that the proposed exemption presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of no significant hazards consideration is justified (i.e., satisfies the provision of 10 CFR 51.22(c)(9)(i)).

Requirements in 10 CFR 51.22(c)(9)(ii)

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same properties as the currently licensed ZIRLO™. The use of the Optimized ZIRLO™ fuel rod cladding material will not significantly change the types of effluents that may be released offsite, or significantly increase the amount of effluents that may be released offsite. Therefore, the provision of 10 CFR 51.22(c)(9)(ii) is satisfied.

Requirements in 10 CFR 51.22(c)(9)(iii)

The proposed exemption would allow the use of the Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same properties as the currently licensed ZIRLO™. The use of the Optimized ZIRLO™ fuel rod cladding material will not significantly increase individual occupational radiation exposure, or significantly increase cumulative occupational radiation exposure. Therefore, the provision of 10 CFR 51.22(c)(9)(iii) is satisfied.

Conclusion

Based on the above, the NRC staff concludes that the proposed exemption meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental

assessment need be prepared in connection with the NRC's proposed issuance of this exemption.

IV. Conclusions

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12, the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants WCNOG an exemption from the requirements of 10 CFR 50.46 and 10 CFR part 50, appendix K, to allow the use of Optimized ZIRLO™ fuel rod cladding material at WCGS. As stated above, this exemption relates solely to the cladding material specified in these regulations.

Dated at Rockville, Maryland, this 2nd day of August 2016.

For the Nuclear Regulatory Commission.

A handwritten signature in black ink, appearing to read 'Anne T. Boland', with a long horizontal flourish extending to the right.

Anne T. Boland, Director,
Division of Operating Reactor Licensing,
Office of Nuclear Reactor Regulation.

August 2, 2016

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

SUBJECT: WOLF CREEK GENERATING STATION – EXEMPTION FROM THE
REQUIREMENTS OF 10 CFR SECTION 50.46 AND APPENDIX K OF
10 CFR PART 50 TO ALLOW THE USE OF OPTIMIZED ZIRLO™ CLAD FUEL
RODS (CAC NO. MF7286)

Dear Mr. Heflin:

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A copy of the exemption is enclosed. The exemption has been forwarded to the Office of the Federal Register for publication.

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

Enclosure
Exemption

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