

**NUCLEAR REGULATORY COMMISSION**

**[Docket Nos. 50-334 and 50-412; NRC-2018-0041]**

**FirstEnergy Nuclear Operating Company; Beaver Valley Power Station**

**Unit Nos. 1 and 2**

**Use Of Optimized ZIRLO™ Fuel Rod Cladding**

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Exemption; issuance.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to an April 9, 2017, request from FirstEnergy Nuclear Operating Company (FENOC), in order to use Optimized ZIRLO™ fuel rod cladding at the Beaver Valley Power Station, Unit Nos. 1 and 2 (Beaver Valley).

**DATES:** The exemption was issued on March 6, 2018.

**ADDRESSES:** Please refer to Docket ID **NRC-2018-0041** 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-2018-0041**. Address questions about NRC dockets to Jennifer Borges; telephone: 301-287-9127; e-mail: [Jennifer.Borges@nrc.gov](mailto:Jennifer.Borges@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](mailto:pdr.resource@nrc.gov). The ADAMS accession number for each document referenced (if it is available in ADAMS) is provided the first time that it is mentioned in this document. In addition, for the convenience of the reader, the ADAMS accession numbers are provided in a table in the "Availability of Documents" section of this document.

- **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:** Tanya E. Hood, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone: 301-415-1387, e-mail: [Tanya.Hood@nrc.gov](mailto:Tanya.Hood@nrc.gov).

**SUPPLEMENTARY INFORMATION:**

**I. Background**

The FirstEnergy Nuclear Operating Company (FENOC) is the holder of Renewed Facility Operating License Nos. 50-334 and 50-412, which authorize operation of Beaver

Valley. The licenses provide, among other things, that the facilities are subject to all rules, regulations, and orders of the NRC now or hereafter in effect. The facilities consist of pressurized-water reactors located in Shippingport Borough on the Ohio River in Beaver County, Pennsylvania. The ZIRLO<sup>®</sup> corrosion model was based on a model originally developed for zircaloy-4 cladding. As utilities moved to increased fuel thermal duty associated with higher peaking factors, uprated core power, and longer cycle lengths, cladding corrosion has become one of the important factors in assessing the potential for increased fuel thermal duty.

## **II. Request/Action**

Pursuant to title 10 of the *Code of Federal Regulations* (10 CFR) section 50.12, “Specific exemptions,” the licensee requested, by letter dated April 9, 2017 (ADAMS Accession No. ML17100A269), an exemption from § 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 Optimized ZIRLO<sup>™</sup> fuel rod cladding for future core reload applications. The regulations in § 50.46 contain acceptance criteria for the ECCS for reactors fueled with zircaloy or ZIRLO<sup>®</sup> 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 different from Optimized ZIRLO<sup>™</sup> material. Therefore, an exemption to § 50.46 and 10 CFR part 50, appendix K, is required to support the use of Optimized ZIRLO<sup>™</sup> fuel rod cladding at Beaver Valley.

The exemption request relates solely to the specific types of cladding material specified in these regulations for use in light-water reactors (i.e., fuel rods with zircaloy

or ZIRLO<sup>®</sup> cladding). This request will provide for the application of the acceptance criteria of § 50.46 and 10 CFR, part 50, appendix K, to fuel assembly designs using Optimized ZIRLO<sup>™</sup> fuel rod cladding.

### **III. Discussion**

Pursuant to § 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 § 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.

The Optimized ZIRLO<sup>™</sup> fuel cladding is different from standard ZIRLO<sup>®</sup> in two respects: 1) the tin content is lower and 2) the microstructure is different. This difference in tin content and microstructure can lead to differences in some material properties. Westinghouse Electric Company (Westinghouse), the manufacturer of Optimized ZIRLO<sup>™</sup> fuel rod cladding, has committed to provide irradiated data and validate fuel performance models ahead of burnups achieved in batch application (i.e., a group of fuel assemblies).

The NRC staff's safety evaluation of Optimized ZIRLO<sup>™</sup> (WCAP-12610-P-A & CENPD-404-P-A) dated June 10, 2005 (ADAMS Package Accession No. ML051670395), included ten conditions and limitations. The NRC staff reviewed FENOC's April 9, 2017, application against these specific conditions and concluded that

the licensee is in compliance with all of the applicable conditions, with the exception of Conditions 6 and 7.

Conditions 6 and 7 relate to validating in-reactor performance and fuel performance models based on lead test assembly data obtained ahead of batch application. Westinghouse provided additional information from irradiation programs to comply with Conditions 6 and 7 of the NRC staff's safety evaluation, by letters dated February 25, 2013 (ADAMS Accession No. ML13070A188), and February 9, 2015 (ADAMS Accession No. ML15051A427), demonstrating compliance with these two conditions.

One of the main objectives of the ongoing Westinghouse creep (growth) program was to confirm the adequacy of the Westinghouse Performance Analysis and Design Model creep models for Optimized ZIRLO™ and verify that the steady state irradiation creep rate is the same in tension and compression. Based upon the supporting data provided by Westinghouse in Figures 3 through 6 of WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A (ADAMS Accession No. ML13070A189), the NRC staff determined that the creep models are adequate for the first operating cycle where the fuel rod cladding is predominately in compressive creep.

The NRC staff performed its review of Conditions 6 and 7 in a letter dated August 3, 2016 (ADAMS Accession No. ML16173A354). The NRC staff determined that the data provided in Westinghouse letters dated February 25, 2013, and February 9, 2015, satisfy Conditions 6 and 7. Therefore, licensees no longer need to provide additional data when referencing WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™," July 2006, in future license amendment requests.

The licensee provided documentation of its compliance with the Westinghouse topical report WCAP-12610-P-A & CENPD-404-P-A Addendum I-A commitments in its

application. Based on that documentation and the information contained in Westinghouse's revised compliance letters dated February 25, 2013, and February 9, 2015, the NRC staff finds the licensee's compliance with safety evaluation Conditions 6 and 7 is acceptable.

**A. The Exemption is Authorized by Law**

This exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material at Beaver Valley. As stated above, § 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR part 50. The fuel that will be irradiated at Beaver Valley contains cladding material that does not conform to the cladding material that is explicitly defined in 10 CFR 50.46 and implicitly defined in 10 CFR part 50, appendix K. However, the criteria of these regulations will continue to be satisfied for the operation of the Beaver Valley cores containing Optimized ZIRLO™ fuel cladding. 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.

**B. The Exemption Presents No Undue Risk to Public Health and Safety**

The objectives of § 50.46(b)(2) and (b)(3) and 10 CFR part 50, appendix K, section I.A.5, are to ensure that cladding oxidation and hydrogen generation are appropriately limited during loss-of-coolant accidents and conservatively accounted for in ECCS evaluation models. As previously documented in the NRC staff's safety evaluation of topical reports submitted by Westinghouse, dated June 10, 2005, 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 the

ECCS acceptance criteria to Optimized ZIRLO™. The NRC staff concluded that oxidation measurements provided by the licensee in the letter from Westinghouse to the NRC, dated November 2007 (ADAMS Accession No. ML073130560), illustrate that oxide thickness and associated hydrogen pickup for Optimized ZIRLO™ at any given burnup would be less than those of both zircaloy-4 and ZIRLO®.

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. Thus, the NRC staff determined that the application of appendix K, section I.A.5, 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. The facility operating licenses require that reload cores be operated in accordance with the operating limits specified in the technical specifications and core operating limits report. Thus, the granting of this exemption request will not pose an undue risk to public health and safety.

**C. The Exemption is Consistent with the Common Defense and Security**

The exemption request would allow the licensee to use an improved fuel rod cladding material. In its letter dated April 9, 2017, 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. Use of Optimized ZIRLO™ fuel rod cladding in the Beaver Valley cores will not adversely affect plant operations. Therefore, the NRC staff has determined that this exemption does not adversely impact common defense and security.

#### **D. Special Circumstances**

Special circumstances, in accordance with § 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 § 50.46 and 10 CFR part 50, appendix K, is to establish acceptance criteria for ECCS performance. The regulations ensure that nuclear power reactors fueled with uranium oxide pellets within zircaloy or ZIRLO<sup>®</sup> cladding must be provided with an ECCS designed to provide core cooling following postulated loss-of-coolant accidents. Westinghouse demonstrated in its NRC-approved topical report WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A that ECCS effectiveness will not be adversely affected by a change from zircaloy or ZIRLO<sup>®</sup> clad fuel to Optimized ZIRLO<sup>™</sup> clad fuel. Normal safety analyses performed prior to core reload will confirm that there is no adverse impact on ECCS performance. Therefore, since the underlying purposes of § 50.46 and 10 CFR part 50, appendix K, are achieved through the use of Optimized ZIRLO<sup>™</sup> fuel rod cladding material, the special circumstances required by § 50.12(a)(2)(ii) for the granting of an exemption exist.

#### **E. Environmental Considerations**

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in § 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: 1) no significant hazards consideration, 2) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and 3) no significant increase in individual or cumulative occupational radiation

exposure. Therefore, in accordance with § 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC staff's consideration of this exemption request. The basis for the NRC staff's determination is discussed in an evaluation of the requirements of § 51.22(c)(9) in the proposed no significant hazards consideration determination for the associated amendment as published in the *Federal Register* on July 18, 2017 (82 FR 32881).

#### IV. Availability of Documents

The NRC is making the documents identified below available to interested persons through one or more of the following methods, as indicated. To access documents related to this action, see ADDRESSES Section of this document.

| Document   | ADAMS<br>Accession No. |
|--|------------------------|
| Beaver Valley Power Station, Unit Nos. 1 and 2, "License Amendment Request to Modify Technical Specifications 4.2.1 and 5.6.3 and a 10 CFR 50.12 Exemption Request to Implement Optimized ZIRLO™ Fuel Rod Cladding" (April 9, 2017)          | ML17100A269            |
| Westinghouse - Final Safety Evaluation for Addendum 1 to Topical Report WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A, "Optimized ZIRLO™" (June 10, 2005)  | ML051670395            |
| Westinghouse - LTR-NRC-13-6, NP-Attachment - SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A "Optimized ZIRLO™" (February 25, 2013)  | ML13070A188            |
| Westinghouse - LTR-NRC- 15-7, Submittal of Responses to Draft RAs 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 (February 9, 2015) | ML15051A427            |
| Westinghouse - LTR-NRC- 13-6 NP-Attachment, SER Compliance of WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A (Non-Proprietary) "Optimized ZIRLO™"(February 2013)  | ML13070A189            |
| Satisfaction of Conditions 6 & 7 of the Safety Evaluation for WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A "Optimized ZIRLO™" Topical Report.  | ML16173A354            |
| SER Compliance with WCAP-12610-P-A & CENPD-404-P-A Addendum 1-A, "Optimized ZIRLO™" (Non-Proprietary) (November 2007)  | ML073130560            |

## **V. Conclusion**

Accordingly, the Commission has determined that pursuant to § 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 FENOC an exemption from the requirements of § 50.46 and 10 CFR part 50, appendix K, to allow the use of Optimized ZIRLO™ fuel rod cladding material at Beaver Valley.

Dated at Rockville, Maryland, this 1<sup>st</sup> day of March, 2018.

For the Nuclear Regulatory Commission.

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Joseph G. Giitter, Director,  
Division of Operating Reactor Licensing,  
Office of Nuclear Reactor Regulation.