

February 11, 2004

Mr. David A. Christian
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SUBJECT: MILLSTONE POWER STATION, UNIT NO. 3, EXEMPTION FROM THE
REQUIREMENTS OF TITLE 10 OF THE CODE OF FEDERAL REGULATIONS
(10 CFR) PART 50.44, 10 CFR 50.46, AND 10 CFR PART 50, APPENDIX K
(TAC NO. MB9897)

Dear Mr. Christian:

The Commission has approved the enclosed Exemption from specific requirements of 10 CFR, Section 50.44, Section 50.46, and Appendix K, for the Millstone Power Station, Unit No. 3. This action is in response to your letter of July 1, 2003, as supplemented November 10, 2003, requesting an exemption from the aforementioned regulations. The Exemption allows the use of up to eight lead test assemblies containing fuel rods, guide thimble tubes, and instrumentation tubes fabricated with Optimized ZIRLO™, a cladding material that contains a nominally lower tin content than the already approved ZIRLO™ material.

A copy of the Exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

/RA/

Victor Nerses, Senior Project Manager, Section 2
Project Directorate 1
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-423

Enclosure: As stated

cc w/enclosure: See next page

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Millstone Power Station
Unit 3

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Millstone Power Station
Unit 3

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION, UNIT NO. 3
DOCKET NO. 50-423
EXEMPTION

1.0 BACKGROUND

Dominion Nuclear Connecticut, Inc. (DNC or the licensee) is the holder of Facility Operating License No. NPF-49 which authorizes operation of Millstone Power Station, Unit No. 3 (MP3). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC or the Commission) now or hereafter in effect. The facility consists of a pressurized water reactor located in Waterford, Connecticut.

2.0 REQUEST/ACTION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.12, "Specific Exemptions," DNC, in a letter dated July 1, 2003, as supplemented November 10, 2003, requested an exemption to 10 CFR 50.44, "Standards for Combustible Gas Control System in Light-Water-Cooled Power Reactors"; 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors"; and Appendix K to 10 CFR Part 50, "ECCS Evaluation Models." The regulation in 10 CFR 50.44 specifies requirements for the control of hydrogen gas generated after a postulated loss-of-coolant accident (LOCA) for reactors fueled with zircaloy or ZIRLO™ cladding. Section 50.46 of 10 CFR contains acceptance criteria for the emergency core cooling system (ECCS) for

reactors fueled with zircaloy or ZIRLO™ cladding. In addition, Appendix K to 10 CFR Part 50 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. This exemption request relates solely to the specific types of cladding material specified in these regulations. As written, the regulations presume the use of zircaloy or ZIRLO™ fuel rod cladding. Thus, an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and Appendix K to 10 CFR Part 50 is needed to irradiate lead test assemblies (LTAs) comprised of a developmental alloy (Optimized ZIRLO™) at MP3.

3.0 DISCUSSION

3.1 Material Evaluation

3.1.1 Fuel Mechanical Design

Tin is a solid solution strengthener and α -phase stabilizer present entirely in the base α -phase zirconium crystalline structure. Potential impacts of a reduced tin content on material properties include: (1) a reduced tensile strength; (2) an increased thermal creep rate; (3) an increased irradiation growth rate; (4) a reduced $\alpha \rightarrow \alpha + \beta$ phase transition temperature; and (5) an improved corrosion resistance. The stated reduction in tin content of Optimized ZIRLO™ will not affect the size, shape, or distribution of any second-phase or inter-metallic precipitates nor the overall microstructure of this developmental zirconium alloy. With a consistent microstructure, Optimized ZIRLO™ will exhibit many material characteristics similar to those of the licensed ZIRLO™.

In response to a Request for Additional Information (RAI), DNC provided details of the planned post-irradiation examinations of the LTAs. Measured parameters include rod profilometry, rod wear, assembly and rod growth, assembly bow, grid cell dimensions, and oxide thickness. As a result of these post-irradiation examinations, any negative aspects of the low tin alloy's performance, including the potential impacts of a reduced tin content identified

above, will be identified and resolved. Furthermore, significant deviations from model predictions will be reconciled.

The fuel rod burnup and fuel duty experienced by the LTAs in MP3 will remain well within the operating experience base and applicable licensed limits for ZIRLO™.

Utilizing currently-approved fuel performance and fuel mechanical design models and methods, DNC and Westinghouse will perform cycle-specific reload evaluations to ensure that the LTAs satisfy design criteria.

Based upon LTA irradiation experience of similar low tin versions of ZIRLO™, expected performance due to similar material properties, and an extensive LTA post-irradiation examination program aimed at qualifying model predictions, the staff finds the LTA mechanical design acceptable for MP3.

3.1.2 Core Physics and Non-LOCA Safety Analysis

The MP3 exemption request relates solely to the specific types of cladding material specified in the regulations. Due to similar material properties, any impact of Optimized ZIRLO™ on the safety analysis models and methods is expected to be minimal. Utilizing currently-approved core physics, core thermal-hydraulics, and non-LOCA safety analysis models and methods, DNC and Westinghouse will perform cycle-specific reload evaluations to ensure that the LTAs satisfy design criteria.

Fuel management guidelines will require that LTAs be placed in non-limiting core locations. In response to an RAI, DNC described how power-peaking margins would be used to ensure that LTAs will not be limiting.

Based upon the use of approved models and methods, expected material performance, and the placement of LTAs in non-limiting core locations, the staff finds that the irradiation of up to eight LTAs in MP3 will not result in unsafe operation or violation of specified acceptable fuel design limits. Furthermore, in the event of a design-basis accident, these LTAs will not promote

consequences beyond those currently analyzed. Based upon results of metal-water reaction tests and ring-compression tests, which ensure the applicability of ECCS models and acceptance criteria and the use of approved LOCA models to ensure that the LTAs satisfy 10 CFR 50.46 acceptance criteria, the staff considers the LTAs acceptable for use at MP3 as proposed by DNC.

3.2 Regulatory Evaluation

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 if: (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) special circumstances are present.

3.2.1 10 CFR 50.44

The underlying purpose of 10 CFR 50.44 is to ensure that means are provided for the control of hydrogen gas that may be generated following a LOCA. The licensee has provided means for controlling hydrogen gas and has previously considered the potential for hydrogen gas generation stemming from a metal-water reaction. The LTA rods of Optimized ZIRLO™ cladding are similar in chemical composition to zircaloy cladding. Metal-water reaction tests performed by Westinghouse on Optimized ZIRLO™ (documented in Appendix B of Addendum 1 to WCAP-12610-P-A) demonstrate comparable reaction rates. Accordingly, the previous calculations of hydrogen production resulting from a metal-water reaction will not be significantly changed. Granting the proposed exemption will not defeat the underlying purpose of 10 CFR 50.44.

3.2.2 10.CFR. 50.46

The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS performance. The applicability of the ECCS acceptance criteria has been demonstrated by

Westinghouse. Ring compression tests performed by Westinghouse on Optimized ZIRLO™ (documented in Appendix B of Addendum 1 to WCAP-12610-P-A) demonstrate an acceptable retention of ductility up to 10 CFR 50.46 limits of 2200 °F and 17% Equivalent Cladding Reacted (ECR).

Utilizing currently approved LOCA models and methods, Westinghouse will perform cycle-specific reload evaluations to ensure that the LTAs satisfy 10 CFR 50.46 acceptance criteria. Granting the proposed amendment will not defeat the underlying purpose of 10 CFR 50.46.

3.2.3 10 CFR Part 50, Appendix K

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rates of energy, 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 the rule would not permit use of the equation for the LTA cladding for determining acceptable fuel performance. Metal-water reaction tests performed by Westinghouse on Optimized ZIRLO™ (documented in Appendix B of Addendum 1 to WCAP-12610-P-A) demonstrate conservative reaction rates relative to the Baker-Just equation. Granting the proposed exemption will not defeat the underlying purpose of Appendix K, Paragraph I.A.5.

3.2.4 Special Circumstances

In summary, the staff reviewed the licensee's request of proposed exemption to allow up to eight LTAs containing fuel rods, guide thimble tubes, and instrumentation tubes fabricated with Optimized ZIRLO™. Based on the staff's evaluation, as set forth above, the staff considers that granting the proposed exemption will not defeat the underlying purpose of 10 CFR 50.44, 10 CFR 50.46, or Appendix K to 10 CFR Part 50. Accordingly, special circumstances, are present pursuant to 10 CFR 50.12(a)(2)(ii).

3.2.5 Other Standards in 10 CFR 50.12

The staff examined the rest of the licensee's rationale to support the exemption request, and concluded that the use of Optimized ZIRLO™ would satisfy 10 CFR 50.12(a) as follows:

- 1) The requested exemption is authorized by law:

No law precludes the activities covered by this exemption request. The Commission, based on technical reasons set forth in rulemaking records, specified the specific cladding materials identified in 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K. Cladding materials are not specified by statute.

- 2) The requested exemption does not present an undue risk to the public health and safety as stated by the licensee:

The LTA reload evaluation will ensure that these acceptance criteria [in the Commission's regulations] are met following the insertion of LTAs containing Optimized ZIRLO™ material. Fuel assemblies using Optimized ZIRLO™ cladding will be evaluated using NRC-approved analytical methods and plant specific models to address the changes in the cladding material properties. The safety analysis for Millstone, Unit No. 3 is supported by the applicable technical specification. The Millstone, Unit No. 3 reload cores containing Optimized ZIRLO™ cladding are required to be operated in accordance with the operating limits specified in the technical specifications. As required by the technical specifications, the LTAs utilizing Optimized ZIRLO™ cladding will be placed in non-limiting core locations. Thus, the granting of this exemption request will not pose an undue risk to public health and safety.

The NRC staff has evaluated these considerations as set forth in Section 3.1 of this exemption. For the reasons set forth in that Section, the staff concludes that Optimized ZIRLO™ may be used as a cladding material for no more than eight LTAs to be placed in non-limiting core locations during MP3's next refueling outage, and that an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K does not pose an undue risk to the public health and safety.

- 3) The requested exemption will not endanger the common defense and security:

The common defense and security are not affected and, therefore, not endangered by this exemption.

4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), 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 DNC an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K, to allow the use of Optimized ZIRLO™ as a cladding material in eight LTAs in the capacity described in their July 1, 2003 submittal, as supplemented November 10, 2003, up to a lead rod average burnup of 62,000 MWD/MTU.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (68 FR 75291).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 11th day of February 2004.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Ledyard B. Marsh, Director
Division of Licensing Project Management
Office of Nuclear Reactor Regulation