7590-01-P

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

STP NUCLEAR OPERATING COMPANY

SOUTH TEXAS PROJECT, UNIT NO. 1 AND 2

DOCKET NOS. 50-498 AND 50-499

EXEMPTION

1.0 BACKGROUND

The STP Nuclear Operating Company (STPNOC or the licensee) is the holder of Facility Operating License Nos. NPF-76 and NPF-80, which authorize operation of South Texas Project (STP), Units 1 and 2, respectively. The licenses provide, among other things, that the facility is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of two pressurized water reactors located in Matagorda County, Texas.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.44, specifies requirements for the control of hydrogen gas generated after a postulated loss-of-coolant accident (LOCA). Section 50.46 of 10 CFR contains acceptance criteria for the emergency core cooling system (ECCS) for reactors with zircaloy or ZIRLO™ clad fuel. Appendix K to 10 CFR Part 50 requires, among other things, that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction. Of these three regulations (10 CFR 50.44, 50.46, and Appendix K to 10 CFR Part 50), 10 CFR 50.44 is the only one that has undergone considerable changes relative to its

previous version, changes that became effective on January 1, 2004. Prior to that date, 10 CFR 50.44 specified requirements for the control of hydrogen gas generated after a postulated LOCA for reactors with zircaloy or ZIRLO™ clad fuel. The new regulation in 10 CFR 50.44 no longer identifies zircaloy or ZIRLO™ as requisite fuel cladding, nor does it identify the LOCA or 10 CFR 50.46 as bases. Because the intent of this exemption request relates solely to the specific types of cladding material specified in these regulations, no exemption is needed from the requirements of 10 CFR 50.44. As written, zircaloy or ZIRLO™ cladding continues to be the requisite fuel cladding that is explicitly identified in 10 CFR 50.46 and Appendix K to 10 CFR Part 50. Therefore, an exemption from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 is needed in order to irradiate up to eight lead test assemblies (LTAs) comprised of low tin (Optimized) ZIRLO™ at the STP, Units 1 and/or 2.

In summary, in a letter dated May 27, 2004 (Reference 1)[1], as supplemented by letter dated August 23, 2004 (Reference 2)[2], STPNOC requested an exemption from 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,” which would allow irradiation of up to eight LTAs containing fuel rods, guide tubes, and instrumentation tubes fabricated with Optimized ZIRLO™. Optimized ZIRLO™ is not within the

---

[1]Letter from T. J. Jordan (South Texas) to U.S. Nuclear Regulatory Commission, "The South Texas Project, Units 1 and 2 Request for Exemption Pursuant to 10 CFR 50.12 Exemption to the Fuel Cladding Material Specified in 10 CFR 50.44, 10 CFR 50.46, and 10 CFR 50 Appendix K," Docket Nos. STN 50-498 and STN 50-499, May 27, 2004, ADAMS Accession No. ML041590200.

[2]Letter from T. J. Jordan (South Texas) to U.S. Nuclear Regulatory Commission, "The South Texas Project, Units 1 and 2 Response to Request for Additional Information Regarding Exemption to Use a Low Tin Cladding," Docket Nos. STN 50-498 and STN 50-499, August 23, 2004, ADAMS Accession No. ML042430272.

licensing basis of the approved ZIRLO™ as described in WCAP-12610-P-A (Reference 3)[3] for STP, Units 1 and 2. Irradiation of up to eight Optimized ZIRLO™ LTAs in STP Units 1 and/or 2 will provide data on fuel and material performance to support future licensing activities.

3.0 DISCUSSION

The staff has previously reviewed exemption requests for LTA programs comprised of fuel with Optimized ZIRLO™ cladding material manufactured by Westinghouse Electric Company (Westinghouse). Exemptions from 10 CFR 50.46 and Appendix K to 10 CFR Part 50 for use of Optimized ZIRLO™ have been issued by the NRC staff for Millstone, Unit 3 (Reference 4)[4], Catawba Station (Reference 5)[5], and Calvert Cliffs, Unit 2 (Reference 6)[6].

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 α : α+β phase transition temperature, and (5) an

---

[3]Westinghouse Electric Company Topical Report, WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995.

[4]Letter from U.S. Nuclear Regulatory Commission to D. A. Christian (Dominion), "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," Docket No. 50-423, February 11, 2004, ADAMS Accession No. ML040070238.

[5]Letter from U.S. Nuclear Regulatory Commission to D. M. Jamil (Duke), "Catawba Nuclear Station, Units 1 and 2 RE: Exemption from the Requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR 50 Appendix K," August 4, 2003, ADAMS Accession No. ML032060473.

[6]Letter from U.S. Nuclear Regulatory Commission to P. E. Katz (Constellation), "Calvert Cliffs Nuclear Power Plant, Unit No. 2," December 3, 2002, ADAMS Accession No. ML022540002.

improved corrosion resistance. The slight reduction in tin content 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 material characteristics very similar to that of ZIRLO™.

In Reference 2, the licensee provided information concerning their post-irradiation examination plan. In Reference 2, the licensee stated that their plan would be consistent with those of the other Optimized ZIRLO™ irradiation programs currently underway. As with the post-irradiation examinations involved in the other irradiation programs, the detailed examinations in the licensee's Optimized ZIRLO™ irradiation program will be based on the fuel duty, cycle performance, need for specific information, and time available on site during refueling outages. The measured parameters will 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 Optimized ZIRLO™ performance, including the potential impacts of 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 Optimized ZIRLO™ LTAs in STP, Units 1 and 2, 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, the STP, Units 1 and 2, and Westinghouse will perform cycle-specific reload evaluations to ensure that the Optimized ZIRLO™ LTAs satisfy design criteria.

Based upon the irradiation experience of LTAs with ZIRLO™ of a similar low tin content, expected performance due to similar material properties, and an extensive LTA post-irradiation examination program aimed at qualifying model predictions, the NRC staff finds the Optimized ZIRLO™ LTA mechanical design acceptable for STP, Units 1 and 2.

3.1.2 Core Physics and Non-LOCA Safety Analysis

The STP, Units 1 and 2, 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, the licensee 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 Reference 2, the licensee described how the power peaking margin 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 NRC staff finds that the irradiation of up to eight Optimized ZIRLO™ LTAs in STP, Units 1 and 2, will not result in unsafe operation nor 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.

3.2 ECCS Performance and Exemptions

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or 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) special circumstances are present. Special circumstances are present if application of the regulation in the particular circumstances would not serve the underlying purpose of the rule, or is not necessary to achieve the underlying purpose of the rule.

The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS performance. In Addendum 1 to WCAP-12610-P-A (Reference 7)[7], Westinghouse demonstrates that the material properties of Optimized ZIRLO™ are similar to those of the currently approved ZIRLO™ cladding and that the ECCS acceptance criteria for ZIRLO™ clad fuel are also applicable to fuel with Optimized ZIRLO™ cladding. Ring compression tests performed by Westinghouse on Optimized ZIRLO™ demonstrate an acceptable retention of ductility up to 10 CFR 50.46 limits of 2200EF peak cladding temperature and 17 percent total oxidation. Utilizing currently approved LOCA models and methods, Westinghouse will perform cycle-specific reload evaluations to ensure that the Optimized ZIRLO™ LTAs satisfy 10 CFR 50.46 acceptance criteria.

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 Optimized ZIRLO™ 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. Thus, application of Appendix K, Paragraph I.A.5, in these circumstances, is not necessary for the licensee to achieve the underlying purpose of the regulation.

Based upon the 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 Optimized ZIRLO™ LTAs satisfy 10 CFR 50.46 acceptance

---

[7]Westinghouse Electric Company Topical Report, Addendum 1 to WCAP-12610-P-A and CENPD-404-P-A, "Optimized ZIRLO", February 2003.

criteria, the NRC staff finds it acceptable to grant an exemption from the requirements of 10 CFR 50.46 and Appendix K to 10 CFR Part 50 for the use of up to eight LTAs in STP, Units 1 and 2.

3.3 Special Circumstances

In summary, the NRC staff has reviewed the licensee's request for an exemption to allow up to eight LTAs containing fuel rods, guide thimble tubes, and instrumentation tubes fabricated with Optimized ZIRLO™ to be used in STP, Units 1 and 2. Based on the NRC staff's evaluation, as set forth above, the NRC staff considers that granting the proposed exemption will not defeat the underlying purpose of 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).

3.4 Other Standards in 10 CFR 50.12

The NRC staff reviewed information provided by the licensee in References 1 and 2 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 50.46 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 in Reference 1:

> The lead test assembly safety evaluation will ensure that these acceptance criteria are met following insertion of the assemblies containing Optimized ZIRLO™ material. Fuel assemblies using Optimized ZIRLO™ cladding will be evaluated using NRC-approved analytical methods and will address the changes in the cladding material properties. The safety analysis for the South Texas Project is supported by the applicable technical specifications. The South Texas Project reload cores containing Optimized ZIRLO™ cladding will continue to be operated in accordance with the operating limits specified in

the technical specifications. Lead test assemblies using Optimized ZIRLO™ cladding will be placed in non-limiting core locations. Therefore, this exemption 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 and 3.2 of this Exemption. For the reasons set forth in Sections 3.1 and 3.2, the NRC staff concludes that Optimized ZIRLO™ may be used as a cladding material for up to eight LTAs to be placed in non-limiting core locations in STP, Units 1 and 2, and that an exemption from the requirements of 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 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 STPNOC an exemption from the requirements of 10 CFR Part 50, Appendix K and Section 50.46, for the use of up to eight LTAs containing Optimized ZIRLO™ in STP, Units 1 and 2, up to a lead rod average burnup of 62,000 megawatt days per metric ton of uranium.

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 (69 FR 45352).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 19th day of October 2004.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

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