



Entergy Nuclear South
Entergy Operations, Inc.
17265 River Road
Killona, LA 70057
Tel 504 739 6440
Fax 504 739-6698
bhousto@entergy.com

Bradford Houston
Director, Nuclear Safety Assurance
Waterford 3

W3F1-2004-0048

June 8, 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Supplement to Request for Exemption to the Cladding Material Specified in 10 CFR 50.46 and 10 CFR 50 Appendix K to Allow Use of Optimized ZIRLO Lead Test Assemblies
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES: 1. Entergy letter dated April 30, 2004 to the NRC, Request for Exemption to the Cladding Material Specified in 10 CFR 50.46 and 10 CFR 50 Appendix K to Allow Use of Optimized ZIRLO Lead Test Assemblies (W3F1-2004-0025)

Dear Sir or Madam:

By letter (Reference 1), Entergy Operations, Inc. (Entergy) requested an exemption to the cladding material specified in 10 CFR 50.46 and 10 CFR Part 50 Appendix K to allow use of Optimized ZIRLO lead test assemblies at Waterford Steam Electric Station, Unit 3 (Waterford 3).

By letter dated May 12, 2004, the Nuclear Regulatory Commission (NRC) requested additional information (RAI) in order to continue review of the Waterford 3 exemption request. Entergy's response is contained in Attachment 1.

There are no technical changes proposed. The original justification of exemption and special circumstances included in Reference 1 is not affected by any information contained in the supplemental letter. This letter contains new commitments as identified in Attachment 2.

ADD1

If you have any questions or require additional information, please contact Dana Millar at 601-368-5445.

Sincerely,

 6/8/04

BLH/DM/cbh

Attachments:

1. Response to Request for Additional Information
2. List of Regulatory Commitments

cc: Dr. Bruce S. Mallett
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

NRC Senior Resident Inspector
Waterford 3
P.O. Box 822
Killona, LA 70066-0751

U.S. Nuclear Regulatory Commission
Attn: Mr. Nageswaran Kalyanam MS O-07D1
Washington, DC 20555-0001

Wise, Carter, Child & Caraway
Attn: J. Smith
P.O. Box 651
Jackson, MS 39205

Winston & Strawn
Attn: N.S. Reynolds
1400 L Street, NW
Washington, DC 20005-3502

Louisiana Department of Environmental Quality
Office of Environmental Compliance
Surveillance Division
P. O. Box 4312
Baton Rouge, LA 70821-4312

American Nuclear Insurers
Attn: Library
Town Center Suite 300S
29th S. Main Street
West Hartford, CT 06107-2445

Attachment 1

To

W3F1-2004-0048

Response to Request for Additional Information

Response to Request for Additional Information Related to Request for Exemption to the Cladding Material Specified in 10 CFR 50.46 and 10 CFR Part 50 Appendix K to Allow Use of Optimized ZIRLO Lead Test Assemblies

By letter dated April 30, 2004, Entergy requested an exemption from the requirements of Title 10 of the Code of Federal Regulations (10 CFR) 50.46, and 10 CFR Part 50 Appendix K. The purpose of this exemption would allow the use of up to four lead test assemblies fabricated with a "low tin" version of ZIRLO™, called Optimized ZIRLO™. The Nuclear Regulatory Commission (NRC) staff has reviewed the information provided and in order to complete the evaluation, the following additional information is requested:

Question 1:

Attachment 1, Page 1, of letter dated April 30, 2004 states, "Westinghouse Electric Company LLC (Westinghouse) has submitted Addendum 1 to WCAP-12610-P-A/CENPD-404-P-A that addresses Optimized ZIRLO™ and demonstrates that Optimized ZIRLO™ has essentially the same properties as currently licensed ZIRLO™ and fits the definition of ZIRLO™ that was used when the "Rule" change was made to 10 CFR 50.46." Review of Addendum 1 is currently underway and this conclusion has not been acknowledged by the staff. Review of this exemption request needs to remain independent of Addendum 1 to WCAP-12610-P-A/CENPD-404-P-A. Instead of referencing Addendum 1, provide all necessary supporting material.

Response 1:

Entergy understands that the staff is currently reviewing Addendum 1 to WCAP-12610-P-A/CENPD-404-P-A and that the review is not complete. The mention of the topical report addendum was to note that substantial testing and confirmation of the new cladding by Westinghouse has been completed. It was not our intent to link the approval of this exemption with the addendum.

Question 2:

Describe the fuel management guidelines and supporting safety analyses used to ensure that the Lead Test Assemblies (LTAs) are not placed in limiting locations.

Response 2:

Non-limiting core regions are those core locations where the LTA will operate with more margin to thermal limits than the lead non-LTA assembly under all normal operating conditions. The Waterford 3 Cycle 14 loading pattern will be developed with the LTAs being placed in core feed locations where the peaking factors are projected to be approximately 5% below the lead assembly in the core. By maintaining approximately 5% margin below the lead assembly, it will be shown that the LTAs will not be limiting from a LOCA peaking factor limit or DNB design criteria under normal operating conditions.

Question 3:

The exemption request does not specify fuel duty targets for the four LTAs.

- *Please provide fuel duty targets for the four LTAs, including projected burnup for each reload cycle.*
- *Is the projected burnup expected to exceed the current licensed limit for ZIRLO™?*
- *Is projected fuel duty expected to exceed limits of less than 100 microns of predicted oxidation with no blistering or spallation?*

Response 3:

- The Waterford 3 LTA program was not designed to achieve any specific fuel duty target. The current projected lead rod burnup for these assemblies, at the end of the first cycle, will be <25,282 MWD/MTU, based on a Cycle 13 shutdown burnup of 18,604 MWD/MTU and a Cycle 14 shutdown burnup of 20,431 MWD/MTU. Loading plans beyond the first cycle of LTA operation have not been finalized. Since the LTAs will be operated approximately 5% below the lead assembly, the fuel duty index for the LTAs will be well within the operating experience base.
- The projected burnup will not exceed the current licensed limit for Combustion Engineering (CE) fuel designs of 60,000 MWD/MTU, which is the same for both ZIRLO™ and Zircaloy cladding. The LTAs have not yet been considered for a high burnup program.
- The 100 micron best estimate oxidation value is an internal Westinghouse limit which will not be exceeded with the Waterford 3 projected fuel duty estimate.

Question 4:

The exemption request does not specify post-irradiation examinations for the four LTAs. Please provide the details of the examinations (e.g., visual, fuel assembly length, fuel assembly bow, fuel assembly drag, fuel rod length, fuel rod wear, fuel rod profilometry, cladding oxidation, etc.) planned for the LTAs.

Response 4:

At the end of each of the three LTA irradiation cycles, various on-site non-destructive post-irradiation examinations (PIE) will be performed on selected LTAs. A listing of the intended inspections to be performed is provided below. The initial inspection schedule agreed upon by Westinghouse and Waterford 3 is as follows:

In the fall of 2006, at the end of the first LTA operating cycle (Cycle 14), no LTAs will be permanently discharged from the core. Visual inspections of the LTAs will be performed in the spent fuel pool during the outage.

At the end of the second LTA operating cycle (Cycle 15), the examinations, described below, will be performed during the outage in the spent fuel pool and then the LTAs will be re-inserted into the core.

LTA Post-Irradiation Examinations

Fuel Assembly Visual: All four faces of the LTAs will be visually examined from the top to the bottom to confirm the mechanical integrity of the assembly.

Fuel Rod Removal: The removed rods are examined / inspected in rack-level equipment and undergo fuel rod visual examination, rod profilometry, and rod oxide thickness measurement.

Cell Size Measurements: This inspection measures the grid cell size of each grid in the assembly.

Fuel Rod Visual: This visual examination is to confirm the mechanical integrity of the fuel rod.

Fuel Rod Wear Measurements: Fuel rod wear will be quantified to determine the loss of cross-sectional area at each wear site over the length of the rod.

Rod Profilometry: This examination obtains the rod diameter change due to cladding creep. The data is used to evaluate the rod retention force.

Assembly Length: This examination provides the assembly growth data.

Assembly Bow: This inspection provides the change in assembly straightness.

Rod-to Nozzle Gap: This inspection provides rod growth data.

Grid Width Measurements: The distance between the two spring slots on the outer strap will be measured on selected grids to determine the grid width change from the non-irradiated nominal dimension.

Fuel Rod Oxide Thickness Measurements: Oxide thickness is measured on the outer grid straps of one face from each of the selected grids in a manner similar to that used for fuel rod oxide measures.

Grid Oxide Thickness Measurements: Oxide thickness is measured on the outer grid straps of one face from each of the selected grids in a manner similar to that used for fuel rod oxide measurements.

At the end of the third LTA operating cycle (Cycle 16), the incore LTAs will be discharged from the core. PIEs are to be performed on the discharged LTAs during the subsequent cycle.

Question 5:

How will Entergy/Westinghouse ensure that fuel performance models and fuel duty predictions remain conservative for this developmental cladding material, especially in subsequent cycles?

Response 5:

The change in the specification of the ZIRLO™ content is expected to enhance the performance of the cladding. The expected performance of the Optimized ZIRLO™ for material properties, corrosion, and thermal creep is described in the original exemption request. No credit for any improved performance will be assumed in fuel performance evaluations of the LTAs. The Byron Station LTA program has confirmed the expected performance of the "low tin" ZIRLO™ and the acceptability of the Westinghouse fuel performance models. In addition, the end of cycle PIE for the Waterford 3 LTA program and other LTA programs will be used to validate the acceptability of the fuel performance models. The PIE measurements will be compared to the model predictions. Significant deviations from these predictions will be addressed and reconciled in the fuel performance models.

Question 6:

Page 4 of Attachment 1 of Entergy letter referenced above states:

"Application of the Baker-Just equation has been demonstrated to be appropriate for the Optimized ZIRLO™ alloy. Due to the similarities in the composition of the Optimized ZIRLO™ and standard ZIRLO™, the application of the Baker-Just equation will continue to conservatively bound all post-LOCA [loss-of-coolant-accident] scenarios."

- In the first sentence, did you mean to state that the Baker-Just equation has been demonstrated to be appropriate for standard ZIRLO™?*
- If yes, please identify where the Baker-Just equation has been previously demonstrated to be appropriate for Optimized ZIRLO™.*

Response 6:

The statement that the Baker-Just equation has been demonstrated to be appropriate for Optimized ZIRLO™ was correctly written. Given the minor differences between Optimized and standard ZIRLO™, the bounding nature of the Baker-Just equation was expected to be preserved. However, Westinghouse did conduct testing to confirm the conservatism of the Baker-Just equation. Please refer to the second paragraph under "Special circumstances support the issuance of an exemption" on page 5 of Attachment 1 to the Waterford 3 exemption request (W3F1-2004-0025). Note that this testing is also documented in Addendum 1 of topical report WCAP-12610-P-A/CENPD-404-P-A.

Question 7:

In page 2 of Attachment 1 of the letter, it states: "The Waterford 3 LTAs may also contain the following changes relative to the current fuel design in the core..." and there are seven changes listed as follows:

"1) a brazed top Inconel grid, 2) advanced Mid grids with "I" spring rod supports, 3) the addition of two Intermediate Flow Mixing (IFM) grids, 4) selected mid grids and IFM grids will have Side Supported mixing vanes, 5) the Mid and IFM grids will be constructed with Optimized ZIRLO™ material, 6) the guide tubes will be fabricated with standard ZIRLO™ material, and 7) the fuel rod design will be the standard Westinghouse 0.374 inch rod instead of the standard Combustion Engineering 0.382 inch rod."

Additionally, on page 3 of Attachment 1, it states: "The features of the LTAs do not challenge the validity of the standard methodologies" and "Thermal-hydraulic LOCA and non-LOCA transient safety analysis evaluations will be performed for the LTAs."

The review of this exemption will be solely for the change in material of the cladding specified in 10 CFR 50.46, namely, from standard ZIRLO™ to Optimized ZIRLO™, and not for the evaluation of the LTA features and/or the evaluations done for the LTAs. Given this, please explain the relevance of such details on 1) changes relative to the current fuel design in the core, 2) features that challenge the validity of the standard methodologies, and 3) evaluation of thermal-hydraulic LOCA and non-LOCA transient safety analysis for the LTAs.

Response 7:

The list of design features was provided for information only and was not intended to be reviewed as part of the exemption request. Entergy understands that the pending NRC approval of the exemption request is solely for the use of the Optimized ZIRLO™ cladding material.

Question 8:

On page 4 of Attachment 1, it states: "Therefore, it can be concluded that the ECCS [emergency core cooling system] performance of the Waterford 3 core will not be adversely affected by the insertion of eight Optimized ZIRLO™ LTAs." Please clarify the discrepancy in the number of LTAs planned to be used.

Response 8:

Waterford 3 plans to allow up to four (4) LTAs.

Attachment 2

To

W3F1-2004-0048

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE- TIME ACTION	CONTINUING COMPLIANCE	
Visual inspections of the LTAs will be performed in the spent fuel pool during the outage.		At the end of cycles 14, 15 & 16	
Non-destructive post-irradiation examinations (PIE) will be performed on the LTAs. These include: fuel assembly visual, fuel rod removal, cell size measurements, fuel rod visual, fuel rod wear measurements, rod profilometry, assembly length, assembly bow, rod to nozzle gap, grid width measurement, fuel rod oxide thickness measurements, and grid oxide thickness measurements.		At the end of cycles 15 & 16	
PIE measurements will be compared to the model predictions. Significant deviations from these predictions will be addressed and reconciled in the fuel performance models.		As part of core reload design while LTAs are in the core.	