

November 21, 2001

Mr. H. A. Sepp, Manager  
Regulatory and Licensing Engineering  
Westinghouse Electric Company  
Energy Center Complex  
Northern Pike  
Monroeville, PA 15146

SUBJECT: SAFETY EVALUATION FOR THE CLOSEOUT OF TOPICAL REPORT  
WCAP-12488-A, ADDENDUM 1, REVISION 1, "WESTINGHOUSE FUEL  
CRITERIA EVALUATION PROCESS"

Dear Mr. Sepp:

By letter dated August 6, 2001, and a revised letter dated October 29, 2001, Westinghouse Electric Company (Westinghouse) submitted Topical Report WCAP-12488-A, Addendum 1, Revision 1, "Westinghouse Fuel Criteria Evaluation Process" for NRC staff review. The review considered replacement of the hydrogen pickup limit criterion for fuel assembly components, excluding cladding, with a new criterion based on the stress level consistent with American Society of Mechanical Engineers (ASME) Code Section III requirements after accounting for thinning due to corrosion.

The staff has completed its review of the subject topical report and finds it acceptable for referencing in licensing applications to the extent specified and under the limitations delineated in the report and in the associated safety evaluation (SE). The SE defines the basis for acceptance of the report.

Pursuant to 10 CFR 2.790, we have determined that the enclosed SE does not contain proprietary information. However, we will delay placing the SE in the public document room for a period of ten working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in the enclosure is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

We do not intend to repeat our review of the matters described in the subject report, and found acceptable, when the report appears as a reference in license applications, except to ensure that the material presented applies to the specific plant involved. Our acceptance applies only to matters approved in the report.

In accordance with procedures established in NUREG-0390, the NRC requests that Westinghouse publish an accepted version, within 3 months of receipt of this letter. The accepted version shall incorporate (1) this letter and the enclosed SE between the title page and the abstract, and (2) an "-A" (designating "accepted") following the report identification symbol.

Should our criteria or regulations change so that our conclusions as to the acceptability of the report are invalidated, Westinghouse and/or the applicants referencing the TR will be expected

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to revise and resubmit their respective documentation, or submit justification for the continued applicability of the TR without revision of their respective documentation.

Sincerely,

**/RA/**

Stuart A. Richards, Director  
Project Directorate IV  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Project No. 700

Enclosure: Safety Evaluation

cc w/encl:  
Mr. Andrew Drake, Project Manager  
Westinghouse Owners Group  
Westinghouse Electric Corporation  
Mail Stop ECE 5-16  
P.O. Box 355  
Pittsburgh, PA 15230-0355

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Sincerely,

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Stuart A. Richards, Director  
Project Directorate IV  
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Pittsburgh, PA 15230-0355

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT WCAP-12488-A, ADDENDUM 1, REVISION 1,

"WESTINGHOUSE FUEL CRITERIA EVALUATION PROCESS"

WESTINGHOUSE ELECTRIC COMPANY

PROJECT NO. 700

1.0 INTRODUCTION

In a letter dated August 6, 2001, Westinghouse Electric Company (Westinghouse) submitted to the NRC Revision 1 to Addendum 1 of WCAP-12488-A, entitled "Westinghouse Fuel Criteria Evaluation Process." WCAP-12488-A is an approved topical report that describes a process and criteria for Westinghouse to apply to changes or improvements in existing fuel designs that will not require NRC review and prior approval when these criteria are met. The submittal revises one fuel licensing criterion to be consistent with current industry guidelines. Specifically, Westinghouse proposes to replace the hydrogen limit criterion of fuel assembly structural components, excluding fuel rods, with a stress criterion that is consistent with the American Society of Mechanical Engineers (ASME) Code Section III requirements after taking into account material thinning due to corrosion. The structural components of a fuel assembly mainly include grid spacers and thimble tubes.

Westinghouse also intended to use a generic term "zircaloy" to apply to both Zircaloy-4 and ZIRLO. In Topical Report WCAP-12610-P-A, entitled "VANTAGE+ Fuel Assembly Reference Core Report," the staff approved the use of ZIRLO for cladding and assembly structural components, and specifically mentioned that ZIRLO is an advanced material different from Zircaloy-4. In addition, the staff recognized that ZIRLO is a patented trade name for Westinghouse with distinguishable chemical compositions from Zircaloy-4. Thus, the staff disagreed with Westinghouse's request to combine ZIRLO and Zircaloy-4 with one generic name that could be misleading and create confusion among the NRC staff, licensees, and members of the public. In a revised submittal dated October 29, 2001, Westinghouse withdrew the request and now references Zircaloy-4 and ZIRLO individually. Thus, the staff agreed with the approach of referring to zircaloy and ZIRLO separately.

2.0 EVALUATION

During reactor operation, fuel assemblies, including cladding and structural components, will absorb significant amounts of hydrogen to form zirconium hydride platelets. These platelets could reduce the ductility due to hydrogen embrittlement. In order to preclude the loss of ductility, Westinghouse restricted the hydrogen pickup to a certain level through the fuel assembly lifetime. However, this criterion for hydrogen content was based on old, unirradiated Zircaloy-4 data. Westinghouse pointed out that recent data for Zircaloy-4 and ZIRLO materials indicated that ductility does not drop drastically and some ductility remains even with the hydrogen concentration higher than the criterion prescribed. Although irradiation reduces the

material ductility, it also increases the material yield and ultimate tensile strengths. The hydrogen pickup criterion does not take into account this aspect of material strength. Thus,

Westinghouse claimed that analyses of irradiated structural components should account for changes in ductility and material strength due to hydrogen pickup and irradiation effects. Westinghouse does not intend to change the hydrogen pickup limit for cladding.

Westinghouse performed tensile tests for grid strap material and assembly thimble tubes. The tests included unirradiated samples at room and elevated temperatures. Some samples were charged with high hydrogen concentration. The results of ductility, yield strength, and ultimate tensile strength were analyzed and compared with the irradiated material properties. The analyses confirmed that the ductility decreases gradually with increasing hydrogen concentration, and a significant amount of ductility exists at operating temperatures and high hydrogen content. The analyses also confirmed that yield and ultimate tensile strengths of irradiated materials are still much higher than those of unirradiated materials. The staff has reviewed these tests and agrees that the analyses are acceptable.

In addition, Westinghouse tested the grid crush strength for seismic and loss-of-coolant accident (LOCA) events as recommended by Standard Review Plan Section 4.2, Appendix A. The grid samples were conditioned in autoclaves with combined effects of oxidation, wall thinning, hydrogen pickup, and deformed grid cells. The results showed that the grid crush strength does not change appreciably from the unirradiated material properties. Westinghouse concluded that the grid crush data from unirradiated grids are still applicable for seismic and LOCA analyses. The staff has reviewed the tests and agrees that the results are acceptable.

Based on these tests and analyses, Westinghouse asserts that the current criterion of using a hydrogen pickup limit for structural components is difficult to verify and does not conform to industry guidelines. The staff agrees with this assessment that structural components other than cladding can be analyzed more adequately using criteria based on mechanical properties such as stress, strain, and material strength.

### 3.0 CONCLUSION

The staff has reviewed the Westinghouse submittal to replace the hydrogen pickup limit criterion for fuel assembly structural components, excluding cladding, with a new criterion based on the stress level consistent with the ASME Code Section III requirements after taking into account thinning due to corrosion. Based on the available tests and adequate analyses, the staff approves the proposed new criterion for structural components of fuel assemblies in Revision 1 to Addendum 1 of WCAP-12488-A.

Principle Contributor: S. Wu

Date: November 21, 2001