

October 18, 2017

Mr. W. Anthony Nowinowski, Program Manager
PWR Owners Group, Program Management Office
Westinghouse Electric Company
1000 Westinghouse Drive, Suite 380
Cranberry Township, PA 16066

SUBJECT: REGULATORY AUDIT PLAN FOR PRESSURIZED WATER REACTOR OWNERS
GROUP LICENSING TOPICAL REPORT PWROG-16043-P, REVISION 2
PWROG PROGRAM TO ADDRESS NRC INFORMATION NOTICE 2012-09:
"IRRADIATION EFFECTS ON FUEL ASSEMBLY SPACER GRID CRUSH
STRENGTH" (CAC NO. MF9280)

Dear Mr. Nowinowski:

By letter dated February 1, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17039B061), Pressurized Water Reactor Owners Group (PWROG) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review the topical report (TR) PWROG-16043-P, Revision 2, "PWROG Program to Address NRC Information Notice 2012-09: 'Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength' for Westinghouse and CE PWR Fuel Designs."

The U. S. Nuclear Regulatory Commission (NRC) staff is currently reviewing the TR, which presents a methodology to develop fuel assembly characteristics and damping coefficients for end-of-life (EOL) conditions that can be used with existing testing and analysis methodologies for seismic and LOCA events. The date for this audit will be October 17, 2017.

This audit will provide information necessary to complete the NRC staff's evaluation of the TR. Enclosed is a copy of the plan the NRC staff will follow on the audit.

If you any questions or require any additional information, please feel free to contact me at 301-415-2767 or Brian.Benney@nrc.gov.

Sincerely,

/RA/

Brian Benney, Sr. Project Manager
Licensing Processes Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Enclosure:
Audit Plan

Project No. 694

SUBJECT: REGULATORY AUDIT FOR PRESSURIZED WATER REACTOR OWNERS
GROUP LICENSING TOPICAL REPORT PWROG-16043-P, REVISION 2
PWROG PROGRAM TO ADDRESS NRC INFORMATION NOTICE 2012-09:
"IRRADIATION EFFECTS ON FUEL ASSEMBLY SPACER GRID CRUSH
STRENGTH" (CAC NO. MF9280) DATED: OCTOBER 18, 2017

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AUDIT PLAN FOR PRESSURIZED WATER REACTOR OWNERS GROUP

LICENSING TOPICAL REPORT PWROG-16043-P, REVISION 2

PWROG PROGRAM TO ADDRESS NRC INFORMATION NOTICE 2012-09:

“IRRADIATION EFFECTS ON FUEL ASSEMBLY SPACER GRID CRUSH STRENGTH”

FOR WESTINGHOUSE AND CE PWR FUEL DESIGNS

PROJECT NO. 694

CAC NO. MF9280

INTRODUCTION

By letter dated February 1, 2017, the Pressurized Water Reactor (PWR) Owners Group (PWROG) submitted a licensing topical report (LTR), which presents a methodology to develop fuel assembly characteristics and damping coefficients for end-of-life (EOL) conditions that can be used with existing testing and analysis methodologies for seismic and loss-of-coolant accident (LOCA) events. The LTR is entitled, “PWROG Program to Address NRC Information Notice 2012-09: ‘Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength’ for Westinghouse [Electric Company (Westinghouse)] and CE [Combustion Engineering] PWR Fuel Designs,” and can be identified by its LTR number, PWROG-16043-P.

Seismic and LOCA events can result in external forces applied to the fuel assemblies (e.g., shaking and/or vibratory forces). Therefore, licensees must evaluate the fuel assembly structural response under these conditions to ensure that regulatory requirements are met with respect to control rod insertability and core coolability. In particular, the spacer grid performance is assessed to determine if plastic deformation occurs. Most PWR plants currently utilize the NRC approved testing and analysis methodologies in WCAP-9401-P-A, “Verification Testing and Analyses of the 17 x 17 Optimized Fuel Assembly,” (for Westinghouse fuel) or CENPD-178-P, “Structural Analysis of Fuel Assemblies for Seismic and Loss of Coolant Accident Loading” (for CE fuel).

The U.S. Nuclear Regulatory Commission (NRC) reviewed and approved WCAP-9401-P-A and CENPD-178-P based on the regulatory guidance provided in Appendix A to Chapter 4.2 of the Standard Review Plan (SRP). One assumption in the SRP 4.2, Appendix A, guidance at the time, which is also in the current revision from 2007, is that beginning of life (BOL) is the time at which the crushing load for the spacer grids would be expected to be at a minimum. This assumption was based on the fact that irradiation tends to cause embrittlement and strengthening in metals and alloys. Since licensees typically verify that the maximum load experienced by the spacer grids during LOCA and seismic events will not exceed the crushing load, the increase in strength was expected to remove other effects of irradiation from consideration.

Operating experience that came to light in the mid-2000s led the NRC staff to question the assumption that the spacer grid structural performance during LOCA and seismic events would not degrade significantly as a result of irradiation. The NRC subsequently issued Information Notice (IN) 2012-09, “Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength.” This

Enclosure

IN lists several factors that can affect the structural strength of the spacer grids, and singles out spacer grid spring relaxation as one that can have a significant effect on the fuel assembly stiffness and the spacer grid strength. While no specific action or response was required as a result of the IN, the NRC indicated that recipients would be expected to review the information for applicability and consider appropriate action to avoid similar problems.

PWROG-16043-P is the PWROG's proposed approach to generically address the issue identified in IN 2012-09 for all licensees that use Westinghouse or CE fuel. In essence, this LTR describes how to extend the testing and analysis methodologies in WCAP-9401-P-A and CENPD-178-P to determine an appropriate crushing load for spacer grids at EOL. In addition, the LTR proposes a methodology that can be used to develop flowing water damping ratios that can then be credited in the LOCA and seismic analyses in a similar manner to the NRC approved still water damping ratios. In summary, the existing NRC approved testing and analysis methodologies will continue to be used, but this LTR extends the applicability of the relevant aspects of these methodologies to the extent necessary to address potential fuel assembly structural performance issues as a result of irradiation.

The NRC staff has determined that an audit, following Office of Nuclear Reactor Regulation Office Instruction LIC-111, "Regulatory Audits," will be beneficial in identifying additional information required to complete the review.

REGULATORY AUDIT BASES

The methodologies described in WCAP-9401-P-A and CENPD-178-P, and by extension, the proposed extension of these methodologies described in PWROG-16043-P, were developed primarily to satisfy NRC regulatory guidelines to meet the regulatory requirements established in Title 10, "Energy," of the *Code of Federal Regulations* (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities," Section 46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," as well as 10 CFR Part 50 Appendix A, "General Design Criteria for Nuclear Power Plants," Criterion 27, "Combined Reactivity Control Systems Capability," and Criterion 35, "Emergency Core Cooling." This requirement is met by acceptance criteria defined in SRP Section 4.2, Appendix A, to demonstrate coolability of the fuel and to ensure insert ability of the control rods.

The NRC staff will audit PWROG-16043-P and supporting documentation, to identify appropriate additional information to request for submittal. Such information would be that required to determine: (1) whether the proposed extension of the methodologies described in WCAP-9401-P-A and CENPD-178-P to irradiated spacer grids is appropriate and technically justified, and (2) whether the testing and analysis methodologies, as described in PWROG-16043, is sufficient to meet the aforementioned regulatory requirements and NRC guidance.

REGULATORY AUDIT SCOPE/OBJECTIVES

The audit is planned to cover the topics listed below.

TESTING DOCUMENTATION

The NRC staff will audit the testing documentation corresponding to the tests referenced in PWROG-16043-P, which includes lattices at beginning of life (BOL) and EOL. Sufficient information should be provided, including pictures if possible, to help the NRC staff better

understand the failure mechanisms and how they are similar or different at EOL compared to BOL. This will allow the NRC staff to determine what specific issues may need to be addressed in order to approve extension of the use of existing methodologies to include lattices at EOL.

METHODOLOGY AREA OF APPLICABILITY DISCUSSION

The NRC staff will discuss several areas related to how this methodology will be generically used to apply to a broad set of possible EOL lattice situations. The NRC staff understands that the testing and analysis methodologies described in PWROG-16043-P are intended for generic use to evaluate any lattice at EOL, in combination with the methodologies described in WCAP-9401-P-A or CENPD-178-P. Particular areas of interest include:

- General applicability and adequacy of the EOL specific methodologies for other grid designs and/or materials
- Adequacy of the PIE data set used to establish the grid cell sizes at EOL
- Consideration of the potential for non-uniform effects due to the steep neutron flux gradients in some locations of the core
- Any limitations on the application of flowing-water damping ratios in LOCA analyses

MISCELLANEOUS EMERGENT QUESTIONS

The NRC staff is continuing to identify and review other documents and resources that may be helpful in forming a complete picture of the relevant technical issues. In the course of the continued review efforts of PWROG-16043, the NRC staff may encounter new issues that would benefit from a discussion during the audit.

ADDITIONAL DISCUSSION AND EXIT MEETING

At the conclusion of the audit, an exit meeting will be held to summarize additional information, if any, that PWROG will be requested to submit to continue the review. Other appropriate next steps, including an update to the LTR review schedule, will be discussed, as well.

TEAM ASSIGNMENTS

The following personnel will be supporting the review:

<u>NAME</u>	<u>AFFILIATION</u>
Scott Krepel	Technical Reviewer, NRC/NRR/DSS
Brian Benney	Project Manager, NRC/NRR/DLP

LOGISTICS AND SCHEDULE

The audit will take place on Tuesday, October 17, 2016, from 10:00 am to 4:00 pm, with an exit meeting at 3:30 pm. The location is the Westinghouse facility at 11333 Woodglen Drive, Suite 202, Rockville, MD, 20852.