NMC
Committed to Nuclear Excellence

Palisades Nuclear Plant
Operated by Nuclear Management Company, LLC

July 5, 2006 10 CFR 54

U. S. Nuclear Regulatory Commission
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Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

Updated NMC Response to NRC Question Relating to License Renewal

In a letter dated April 26, 2006, NMC responded to a verbal NRC question relating to classification of a generic issue, underclad cracking, as a potential Time-Limited Aging Analysis (TLAA) at Palisades. The letter stated that NMC would reclassify the issue as a TLAA at Palisades, and provided a preliminary discussion of the new TLAA for the License Renewal Application (LRA). The letter also committed to either confirm or revise the preliminary LRA discussion of the issue when the final technical report was completed.

The final technical report has now been completed. This report has identified the need to update the preliminary information submitted in NMC's April 26, 2006 letter. Therefore, a revised response to NRC's verbal question on underclad cracking is provided in Enclosure 1. This response supersedes NMC's previous response.

Please contact Mr. Robert Vincent, License Renewal Project Manager, at 269-764-2559, if you require additional information.

Summary of Commitments

This letter closes one previous commitment contained in NMC letter dated April 26, 2006.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 5, 2006.

Paul A. Harden
Site Vice President, Palisades Nuclear Plant
Nuclear Management Company, LLC

Enclosure

CC Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC
License Renewal Project Manager, Palisades, USNRC

ENCLOSURE 1

Updated NMC Response to NRC Question Relating to Underclad Cracking as a TLAA

(5 Pages)

Background

In a letter dated March 30, 2006, NMC responded to an NRC follow up question on the classification of underclad cracking as a potential Time-Limited Aging Analysis (TLAA) for Palisades. In that letter NMC provided a commitment either to supplement the existing discussion on the subject in the LRA, or to revise the LRA to discuss the issue as a TLAA.

In a letter dated April 26, 2006, NMC classified the issue as a TLAA and provided preliminary LRA changes that reflected the expected technical conclusion for the issue. The LRA changes were based on preliminary information from the NSSS vendor, and referenced a Westinghouse report, WCAP-15338-A, "A Review of Cracking Associated With Weld Deposited Cladding in Operating PWR Plants." This report had been prepared to address the issue of underclad cracking for all Westinghouse plants with reactor vessels fabricated by Combustion Engineering and other suppliers. The NRC had reviewed WCAP-15338 and found it acceptable for referencing by Westinghouse plants pursuing license renewal, subject to confirmation that the design transients and operating conditions assumed in the report were applicable to the applicant's plant. NMC's April 26, 2006 letter also committed to notify NRC when the final technical report on the effects of potential underclad cracking at Palisades was completed, and to either confirm the preliminary LRA changes or provide revised information for NRC review and approval.

The final technical report has been completed. Since Palisades is a Combustion Engineering plant that is not explicitly addressed in WCAP-15338-A, Westinghouse has documented the Palisades technical evaluation in a separate plant-specific report, rather than via reference to WCAP-15338-A. The generic information in WCAP-15338-A was modified to incorporate Palisades-specific design transients and operating conditions, and inservice inspection results, and the report was issued as WCAP-16605-NP, "A Review of Cracking Associated with Weld Deposited Cladding at Palisades Nuclear Plant." Consistent with WCAP-15338-A, the Palisades report concludes that the presence of underclad cracks has no effect on structural integrity, and little or no crack growth is expected for a period of 60 years. A copy of WCAP-16605-NP is available on site for NRC review.

To reflect the plant-specific report as providing the technical disposition of this issue, rather than WCAP-15338-A, the information provided in NMC letter of April 26, 2006, is hereby revised to read as follows:

LRA Revisions Related to Potential Underclad Cracking

The LRA is revised to add a new LRA Section 4.7.6, to read as follows:

4.7.6 Reactor Vessel Underclad Cracking

The issue of underclad cracking in reactor pressure vessels (RPV) has been identified since 1970 when it was first discovered at a European vessel fabricator. Underclad cracking has occurred in the low alloy steel base metal heat-affected zone (HAZ) beneath the austenitic stainless steel weld overlay that is deposited to protect the ferritic material from corrosion. Two types of underclad cracking have been identified. Reheat cracking has occurred as a result of postweld heat treatment of austenitic stainless steel cladding applied using high-heat-input welding processes on ASME SA-508, Class 2 forgings. Cold cracking has occurred in ASME SA-508, Class 3 forgings after deposition of the second and third layers of cladding, when no pre-heating or post-heating was applied during the cladding procedure. The cold cracking was determined to be attributable to residual stresses near the yield strength in the weld metal/base metal interface after cladding deposition, combined with a crack-sensitive microstructure in the HAZ, and high levels of diffusible hydrogen in the austenitic stainless steel or Inconel weld metals. The hydrogen diffused into the HAZ and caused cold (hydrogen-induced) cracking as the HAZ cooled.

Westinghouse report WCAP-15338-A, "A Review of Cracking Associated With Weld Deposited Cladding in Operating PWR Plants," summarizes the original disposition of the issue as follows,

> "In 1971 Westinghouse submitted an assessment of the underclad reheat cracking issue to the regulatory authorities, then the Atomic Energy Commission, evaluating underclad cracks for an operating period of 40 years. The commission reviewed the assessment, and issued the following conclusion:
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> SUMMARY OF REGULATORY POSITION:
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> 'We concur with Westinghouse's finding that the integrity of a vessel having flaws such as described in the subject report would not be compromised during the life of the plant. This report is acceptable and may be referenced in future applications where similar underclad grain boundary separations have been detected. However, such flaws should be avoided, and we recommend that future applicants state in their PSARs what steps they plan to take in this regard.' "

WCAP-15338-A notes that a 1983 inservice inspection at Palisades identified two small clusters of underclad indications, classified as reheat cracks, that were determined to be within the allowable limits of ASME B&PV Code, Section XI, IWB-3500. When these locations were again inspected in 1995 there was no evidence that the indications had expanded in number or size.

This issue has not previously been addressed in Palisades' licensing bases.

Analysis

A generic fracture mechanics evaluation of Westinghouse plants initially demonstrated that the growth of underclad cracks during a 40-year plant life was insignificant. The evaluation was extended to 60 years, using fracture mechanics analysis based on a representative set of design transients, with the occurrences extrapolated to cover 60 years of service life. The 60-year evaluation (WCAP-15338-A) (Reference 8) showed insignificant growth of the underclad cracks, and concluded that the cracks were of no concern relative to structural integrity of the reactor vessel. The NRC reviewed and approved WCAP-15338-A for application to all Westinghouse reactor pressure vessels (RPVs) (Reference 9), and identified two plant-specific Applicant Action Items to be completed by each applicant as a condition for referencing WCAP-15338-A. These action items include verifying that the design transients and operating conditions assumed in the report are applicable to the applicant's plant, and providing a description of the issue as a TLAA to be incorporated into the FSAR.

Palisades is not a Westinghouse plant that was specifically addressed by WCAP-15338-A. However, the Palisades reactor vessel was fabricated using similar processes and materials as those used in reactor vessels fabricated by Combustion Engineering for Westinghouse. Therefore, using the same methodology as WCAP-15338-A, Westinghouse prepared a Palisades-specific evaluation of underclad cracking, WCAP-16605-NP, "A Review of Cracking Associated with Weld Deposited Cladding at Palisades Nuclear Plant" (Reference 10). This evaluation demonstrates that any potential growth of underclad cracks during a 60-year plant life would be insignificant, and concludes that the cracks are of no concern relative to structural integrity of the reactor vessel. This is the same conclusion reached previously in WCAP-15338-A and accepted by the NRC.

Disposition: 10 CFR 54.21(c)(1)(ii)

Reactor vessel underclad cracking is dispositioned under 10 CFR 54.21(c)(1)(ii), the analysis has been projected to the end of the period of extended operation.

The LRA Section 4.7 References on page 4-65 are revised to add the following:

8. Westinghouse WCAP 15338-A, "A Review of Cracking Associated with Weld Deposited Cladding in Operating PWR Plants," October 2002.

9. NRC Letter, "Revised Safety Evaluation of WCAP-15338 "A Review of Cracking Associated with Weld Deposited Cladding in Operating Pressurized Water Reactor (PWR) Plants," To: Roger A. Newton, WOG Chairman, From: Pao-Tsin Kuo, Program Director, Dated September 25, 2003.

10. Westinghouse WCAP-16605, "A Review of Cracking Associated with Weld Deposited Cladding at Palisades Nuclear Plant," June 2006

LRA Section 3.1.2.2.5 is revised to replace the existing discussion in its entirety with the following:

3.1.2.2.5 Crack Growth due to Cyclic Loading

NUREG-1800 states that crack growth due cyclic loading could occur in reactor vessel shell and reactor coolant system piping and fittings. Growth of intergranular separations (underclad cracks) in low-alloy or carbon steel heat affected zone under austenitic stainless steel cladding is a time-limited aging analysis (TLAA) to be evaluated for the period of extended operation for all the SA 508-Cl 2 forgings where the cladding was deposited with a high heat input welding process.

Underclad cracking in carbon/low-alloy steel, which has been clad with austenitic stainless steel using weld-overlay processes, has been identified as an aging effect requiring management and is addressed as a TLAA. An evaluation of the TLAA for underclad cracking is contained in Section 4.7.6.

LRA Appendix A is revised to add the new section A4.5.6, to read as follows:

A4.5.6 Reactor Vessel Underclad Cracking

The issue of underclad cracking in certain reactor vessels has been identified since 1970 when it was first discovered at a European vessel fabricator. Underclad cracking has occurred in the low alloy steel base metal heat-affected zone (HAZ) beneath the austenitic stainless steel weld overlay that is deposited to protect the ferritic material from corrosion. Two types of underclad cracking have been identified. Reheat cracking has occurred as a result of postweld heat treatment of austenitic stainless steel cladding applied using high-heat-input welding processes on ASME SA-508, Class 2 forgings. Cold cracking has occurred in ASME SA-508, Class 3 forgings after deposition of the second and third layers of cladding, when no pre-heating or post-heating was applied during the cladding procedure. The cold cracking was determined to be attributable to residual stresses near the yield strength in the weld metal/base metal interface after cladding deposition, combined with a crack-sensitive microstructure in the HAZ, and high levels of diffusible hydrogen in the austenitic stainless steel or Inconel weld metals. The hydrogen diffused into the HAZ and caused cold (hydrogen-induced) cracking as the HAZ cooled.

Westinghouse report WCAP-15338-A, "A Review of Cracking Associated With Weld Deposited Cladding in Operating PWR Plants," summarizes the original disposition of the issue as follows,

> "In 1971 Westinghouse submitted an assessment of the underclad reheat cracking issue to the regulatory authorities, then the Atomic Energy Commission, evaluating underclad cracks for an operating period of 40

years. The commission reviewed the assessment, and issued the following conclusion:

SUMMARY OF REGULATORY POSITION:

'We concur with Westinghouse's finding that the integrity of a vessel having flaws such as described in the subject report would not be compromised during the life of the plant. This report is acceptable and may be referenced in future applications where similar underclad grain boundary separations have been detected. However, such flaws should be avoided, and we recommend that future applicants state in their PSARs what steps they plan to take in this regard.' "

WCAP-15338-A notes that the 1983 inservice inspection identified two small clusters of underclad indications, classified as reheat cracks, that were determined to be within the allowable limits of ASME B&PV Code, Section XI, IWB-3500. When these locations were again inspected in 1995 there was no evidence that the indications had expanded in number or size.

Analysis

A generic fracture mechanics evaluation of Westinghouse plants initially demonstrated that the growth of underclad cracks during a 40-year plant life was insignificant. The evaluation was extended to 60 years, using fracture mechanics analysis based on a representative set of design transients with the occurrences extrapolated to cover 60 years of service life. The 60-year evaluation (WCAP-15338-A) showed insignificant growth of the underclad cracks, and concluded that the cracks were of no concern relative to structural integrity of the reactor vessel. The NRC reviewed and approved the evaluation (WCAP-15338-A) for application to all reactor pressure vessels (RPVs) in Westinghouse plants.

Palisades is not a Westinghouse plant that was specifically addressed in WCAP-15338-A. However, the Palisades reactor vessel was fabricated using similar processes and materials as those used in reactor vessels fabricated by Combustion Engineering for Westinghouse. Therefore, a Palisades-specific evaluation has been performed and documented in WCAP-16605-NP, "A Review of Cracking Associated with Weld Deposited Cladding at Palisades Nuclear Plant." This evaluation demonstrates that any potential growth of underclad cracks during a 60-year plant life would be insignificant, and concludes that underclad cracks are of no concern relative to structural integrity of the reactor vessel. This is the same conclusion reached previously in WCAP-15338-A and accepted by the NRC.

Disposition: 10 CFR 54.21(c)(1)(ii)

Reactor vessel underclad cracking is dispositioned under 10 CFR 54.21(c)(1)(ii), the analysis has been projected to the end of the period of extended operation.