NMC
Committed to Nuclear Excellence

Palisades Nuclear Plant
Operated by Nuclear Management Company, LLC

February 28, 2003

U. S. Nuclear Regulatory Commission
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DOCKET 50-255
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PALISADES NUCLEAR PLANT
SUPPLEMENT TO PALISADES RISK-INFORMED INSERVICE INSPECTION PIPING PROGRAM

By letter dated March 1, 2002, Nuclear Management Company, LLC (NMC) proposed a Risk-Informed Inservice Inspection (RI-ISI) Program as an alternate to the current American Society of Mechanical Engineers (ASME) Code, Section XI inservice inspection requirements for piping. The program is based on Westinghouse Topical Report, WCAP-14572, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," Revision 1-NP-A and WCAP-14572, Supplement 1, "Westinghouse Structural Reliability and Risk Assessment (SRRA) Model for Piping Risk-Informed Inservice Inspection," Revision 1-NP-A.

On June 13, 2002, the Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI). NMC responded to the RAI on August 8, 2002.

NMC is further providing the attached supplement to the original program submittal. This supplement commits to additional piping weld inspections on high safety significant segments defined in the program to address the NRC's concern that the NMC program for Palisades contains a potential deviation from the approved WCAP methodology. This commitment will be reassessed, as it pertains to the remainder of the current inspection interval and the next inspection interval, upon ultimate resolution of the NRC's concern by the Westinghouse Owners Group.

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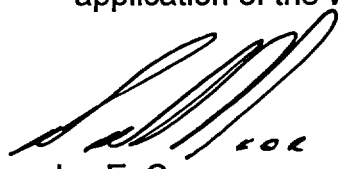
SUMMARY OF COMMITMENTS

This letter contains the following new commitment:

- NMC will complete additional piping weld inspections, in accordance with the supplement to the RI-ISI program for the Palisades Plant, during the remainder of the third inspection interval. This commitment will be reassessed, as it pertains to the remainder of the current inspection interval and the next inspection interval, based upon the ultimate resolution of the NRC's concern with the application of the WCAP methodology at Palisades.



Douglas E. Cooper
Site Vice-President, Palisades Nuclear Plant

CC Regional Administrator, USNRC, Region III
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Attachment

ATTACHMENT 1

NUCLEAR MANAGEMENT COMPANY, LLC
PALISADES NUCLEAR PLANT
DOCKET 50-255

FEBRUARY 28, 2003

SUPPLEMENT TO PALISADES NUCLEAR PLANT RISK-INFORMED INSERVICE INSPECTION PIPING PROGRAM

8 Pages Follow

SUPPLEMENT TO PALISADES NUCLEAR PLANT
RISK-INFORMED INSERVICE INSPECTION PIPING PROGRAM

1. BACKGROUND / RELATION TO ORIGINAL SUBMITTAL

1.1 Original Submittal Background

By letter dated March 1, 2002, "Relief Request: Alternate ASME Code, Section XI, Risk-Informed Inservice Inspection Program," Nuclear Management Company, LLC (NMC) requested approval to implement a Risk-Informed Inservice Inspection (RI-ISI) Program for Palisades. NMC proposed the RI-ISI Program as an alternate to the current American Society of Mechanical Engineers (ASME) Code, Section XI inservice inspection requirements for piping. The proposed RI-ISI Program is based on Westinghouse Topical Report, WCAP-14572, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," Revision 1-NP-A and WCAP-14572, Supplement 1, "Westinghouse Structural Reliability and Risk Assessment (SRRA) Model for Piping Risk-Informed Inservice Inspection," Revision 1-NP-A (referred to as "WCAP" for the remainder of this document).

1.2 Reason for Supplemental Information

NMC is providing this supplement to the March 1, 2002 RI-ISI Program submittal to address the NRC's concern that the proposed RI-ISI Program for Palisades contains a potential deviation from the approved WCAP methodology. NMC reviewed the March 1, 2002 submittal, the NRC RI-ISI audit results, the WCAP, and upon further discussion with the NRC Staff, determined that enhancements to the application of the WCAP methodology at Palisades were necessary to aid in the review and approval of the proposed RI-ISI Program. The enhancements to the application of the WCAP methodology at Palisades provide conservative results that address the NRC Staff concerns of how NMC originally applied the WCAP methodology to the proposed RI-ISI Program at Palisades. As a result of these enhancements, additional piping inspections on high safety significant systems (HSS) were added to the program. This supplement commits to additional piping weld inspections on high safety significant segments defined in the program.

2. NRC STAFF CONCERNS

The NRC Staff conducted a site audit of the risk-informed documentation supporting the Palisades inservice inspection relief request (proposed RI-ISI Program submittal) on September 12-13, 2002. The NRC Staff noted that numerous segments were divided into sub-segments, failure probability estimates were developed for one or more of the sub-segments, and the failure probability estimate of one of the sub-segments was used for the entire segment. The NRC Staff identified that page 71 of the WCAP states the following:

> "The failure probability of a segment is characterized by the failure potential (probability or frequency as appropriate) of the worst case situation in each segment (not a selected weld in each segment). This is calculated by the SRRA

code by inputting the conditions (typically, the most limiting or bounding) for the entire piping segment. Essentially, the piping failure probability is a representation or characterization of the piping segment."

The NRC Staff understands that the application of the methodology at Palisades applies this guidance to individual sub-segments but not to the entire segment. Therefore, the NRC Staff believes that NMC deviates from the approved methodology.

The NRC Staff also noted that NMC applied the Perdue methodology independently to individual sub-segments. The NRC Staff identified that pages 170 and 171 of the WCAP discuss application of the Perdue methodology:

"Segment #: This is the name for the lot from which a sample of structural elements (such welds, pipe elbows, branch connections, etc.) is to be taken. Generally, each piping segment is defined as a lot. However, segments that are similar (e.g., all the cold legs on each reactor coolant loop with the same postulated failure mechanism) may be combined to define a lot.

Number of Welds or Elements: This is the number of structural elements in the lot.

Probability of a Flaw (@specified year/weld): The probability of an unacceptable flaw in the segment's 'most likely to fail' weld (or typical weld, if they are viewed as clones) at the current age of the weld (usually the current age of the plant unless the pipe has been repaired or replaced). An unacceptable flaw is defined by the ASME Section XI Code. This has been defined as a/t > 0.10 and is obtained from the probabilistic fracture mechanics code (e.g., SRRA)."

At the site audit exit meeting, the NRC Staff noted that supplemental information regarding the use of sub-segments would be needed to complete the review of the relief request. The NRC Staff requested the following information:

1) For the failure probability estimation for segments that were subdivided, provide the definitions used to identify sub-segments. Also, explain how the failure probability estimates are developed for a segment that has been divided into sub-segments and how the Palisades methodology comports with the approved methodology.

2) For the Perdue method application on segments that were subdivided, provide the definitions used to identify sub-segments. Also, explain how the Perdue input parameters are developed for a segment that has been divided into sub-segments, how the results are used to determine the number of locations for inspection in the segment, and how the Palisades methodology comports with the approved methodology.

3) If Palisades were to apply the failure probability estimation and the Perdue methodology to the entire segment for all segments, as opposed to sub-segments, how would the total number of inspections required in the RI-ISI program change?

2.1 Response to the NRC Requested Information

2.1.1 Response to NRC Request 1

To evaluate the importance of the piping in each system included in the program, piping segments were defined based on the guidance in WCAP Section 3.3. Direct consequences were identified based on the guidance in WCAP Section 3.4.1 and used as the primary factor to initially divide piping systems into segments. Indirect consequences for each segment were identified based on the guidance in WCAP Section 3.4.2 and used to further divide piping systems into segments. Therefore, a piping failure in any portion of a segment resulted in the same consequences (both direct and indirect). This method led to some segments consisting of piping with a variety of pipe diameters. For example: a four-inch diameter pipe with a two-inch diameter branch line may be part of the same piping segment if a failure at any portion of the segment would result in the same consequences. The Palisades Probabilistic Safety Assessment (PSA) was used to quantify the effects of the postulated consequences (direct and indirect) for each segment. Section 3.2 and Section 3.3 of the March 1, 2002 submittal provided details on segment definitions and consequence evaluation.

The failure probability estimate for a segment was determined in accordance with the guidance in WCAP Section 3.5 using the Westinghouse Structural Reliability and Risk Assessment Model (Win-SRRA). The Win-SRRA code requires 18 input parameters associated with the piping. Some of the input parameters used by the Win-SRRA code depend on pipe specific properties (e.g. nominal pipe size and thickness to outer diameter ratio). Sub-segments were defined to facilitate failure probability estimating using Win-SRRA for piping segments that contain multiple pipe sizes. Therefore, segments with multiple pipe sizes were divided into sub-segments with each sub-segment containing only one pipe size. Failure probability estimates for segments made up of multiple pipe sizes were determined by performing multiple Win-SRRA cases, one Win-SRRA case for each sub-segment. Limiting inputs, based on the expected degradation mechanisms for the specific sub-segment, were developed for each Win-SRRA case in accordance with the guidance in WCAP Section 3.5. The highest sub-segment failure probability associated with a segment was used to represent the segment failure probability for risk ranking purposes. Section 3.4 of the March 1, 2002 submittal provided details on segment failure probability estimation.

Further enhancements to the application of the WCAP methodology at Palisades and how it comports with the WCAP/approved methodology are discussed in this supplement in Section 3.2, "Enhancements to the Palisades Application of the WCAP Methodology."

2.1.2 Response to NRC Request 2

Determination of the number of structural elements for examination for each of the HSS segments (including the additions due to the change in risk calculation) was performed in accordance with the WCAP Section 3.7. Section 3.8 of the March 1, 2002 submittal provided details on the structural element selection process. Welds in sub-segments were included in the segment weld count for each multiple line size segment.

All small bore (two-inch and under) welds at Palisades are socket welds. As noted on page 178 of the WCAP, the Perdue model should not be used on socket welds. All HSS segment small bore piping welds were included in the proposed RI-ISI Program and will receive a visual (VT-2) examination each refueling outage. Therefore, socket welds were not included in the weld counts when applying the Perdue methodology.

Also, if there was an active, or several active, degradation mechanisms for a group of welds in a segment, inspections for the identified active degradation mechanism(s) in the group were included in the proposed RI-ISI Program. Therefore, these welds were not included in the weld counts when applying the Perdue methodology to the rest of the HSS segment with the active degradation mechanism(s) removed.

Perdue was run for each HSS segment with the weld counts equal to the total number of welds in the segment (including sub-segment welds) minus the small bore, the active degradation mechanism welds and augmented inspection welds. The most limiting inputs from each pipe size (after removing active degradation mechanisms) would initially be used and the segment was analyzed as one lot. If this proved too conservative, then each pipe size would be analyzed separately with the appropriate number of welds and SRRA results. The confidence values of each lot were then multiplied together to obtain the confidence of the segment. This value was then compared to the 95% confidence level acceptance criterion.

Successful results from the Perdue model resulted in the addition of one weld inspection per segment (beyond the VT-2, active degradation mechanism and augmented inspections). The Perdue model could not analyze four segments with thin walled pipe (Section 3.8 of the March 1, 2002 submittal provides further details). The proposed RI-ISI Program includes 7.5% of the total weld count (including all sub-segment welds) for these four segments. Further enhancements to the Palisades application of the WCAP methodology and how it comports with the WCAP/approved methodology are discussed in this supplement in Section 3.2, "Enhancements to the Palisades Application of the WCAP Methodology."

2.1.3 Response to NRC Request 3

To address the NRC Staff concerns of how NMC applied the WCAP methodology to the proposed RI-ISI Program, Section 3.2, "Enhancements to the Application of the WCAP Methodology at Palisades," describes additional enhancements of the WCAP application. Additional inspections to be performed, including those from NMC's August 8, 2002 response to the NRC request for additional information (RAI), are discussed in Section 4.

3. APPLICATION OF THE WCAP METHODOLOGY AT PALISADES

3.1 Reason for Enhancements to the Application of the WCAP Methodology at Palisades

As stated in Section 1.2 of this supplement, enhancements to the application of the WCAP methodology at Palisades are being provided following a review of the March 1, 2002 submittal, the NRC RI-ISI audit results, the WCAP and upon further discussions with the NRC Staff. NMC has enhanced its application of the WCAP methodology for determining the number of inspections. A change in risk sensitivity has also been performed. This enhanced application to the WCAP methodology addresses the NRC Staff concerns of how NMC applied the WCAP methodology to the proposed RI-ISI Program. NMC has implemented these enhancements to the application of the WCAP methodology to aid in the review and approval of the proposed RI-ISI Program.

3.2 Enhancements to the Application of the WCAP Methodology at Palisades

The enhancements to the application of the WCAP methodology at Palisades results in a conservative application of the methodology. NMC enhanced the application of the WCAP methodology to aid in the review and approval of the proposed RI-ISI Program.

The NRC Staff believes that applying degradation mechanisms to sub-segments, and not applying the worst case from each sub-segment to the entire segment to determine segment failure probabilities, is a deviation from the WCAP methodology. To facilitate NRC review and approval of the proposed RI-ISI Program, NMC enhanced the structural element selection process to identify the HSS segments that contain multiple pipe sizes and included additional inspections to ensure each pipe size in the HSS segments in the proposed RI-ISI Program have at least one inspection. No additional inspections from low safety significant (LSS) multiple pipe size segments were added to the proposed RI-ISI Program.

The enhanced structural element selection process divided HSS segments with multiple pipe sizes into sub-segments based on pipe size. The new sub-segments would all have the same consequences but would have unique probabilities based on their unique SRRA analysis. This would result in one or more of the sub-segments having the same HSS risk value as the original segment since the worst case SRRA run was used for the segment's risk determination, with the remaining sub-segments having risk

values somewhat smaller. Depending on the order of magnitude, some of the sub-segments may have risk values in the LSS range. However, NMC's enhanced application of the WCAP methodology conservatively applied the segment failure probability to all sub-segments, resulting in all sub-segments having the same HSS categorization.

Since the LSS segments used the worst-case SRRA values, there is no need to subdivide them for structural element selection since none of the sub-segments would have higher risk values than the original segment. Thus no existing LSS segments would become HSS.

These enhancements to the application of the WCAP methodology at Palisades address the NRC Staff concerns and comports with the WCAP by conservatively treating each HSS sub-segment as a segment in the structural element selection process. The failure probability was estimated for each segment, either directly (segments with no sub-segments) or by conservative comparison (sub-segments treated same as segment probability). The Perdue methodology, after removal of active degradation mechanisms, only identified one weld inspection per HSS segment. Since all active degradation mechanisms have already been identified for inspection per the existing acceptable Perdue analyses, adding one additional weld inspection to each sub-segment that does not currently receive an inspection would be consistent with the Perdue results for each HSS segment.

3.3 Change in Risk Sensitivity

3.3.1 Original Change in Risk Calculation

The WCAP prescribed change in risk calculation evaluated the net change in risk for performing the weld inspections per the RI-ISI Program versus the current ASME Section XI inspection program. The change in risk calculation and comparison to acceptance criteria were performed in accordance with the guidance in WCAP Section 4.4.2. The segment failure probability was used when determining the change in risk.

In the initial application of the WCAP risk ranking analyses eight segments were found to dominate the risk results. These segments, classified as HSS segments, were removed from further consideration and not evaluated in any subsequent change in risk analysis. It is very conservative not to include these segments in the change in risk calculations, as they would show a dramatic reduction in risk by implementing the RI-ISI Program because they are not part of the current Section XI ISI program. These segments are included in the proposed RI-ISI program.

The results of the change in risk analysis (without the initial eight dominant risk segments) showed that moving from the current ASME Section XI ISI program to the proposed RI-ISI Program is a risk reduction for Palisades. All of the WCAP criteria were met with the inclusion of five additional segments into the proposed RI-ISI program to address the change in risk requirements.

3.3.2 Change in Risk Sensitivity

As a result of the change in the number of inspections and questions from the NRC Staff about the affect of sub-segments on the change in risk calculation, a change in risk sensitivity was performed. For the change in risk sensitivity, the HSS segments (including those segments added for change in risk) were treated the same as in the original change in risk calculation. That is, the HSS sub-segments were not treated as segments. This is conservative in that if more segments that receive inspection in the proposed RI-ISI program were added it would lead to relatively lower RI-ISI risk results. By not treating HSS sub-segments as segments, the RI-ISI risk results are kept artificially high. Conversely, the LSS segments were divided into sub-segments, by pipe size, and the sub-segments were treated as segments. Since the LSS segments do not receive an inspection in the proposed RI-ISI Program, including additional LSS segments will increase the RI-ISI risk results. Also, the LSS segments included in the current ASME Section XI Program would be credited for inspections in the current ASME program, thus contributing to lowering risk for that program. Therefore, considering multiple sub-segments only in the LSS segments will tend to reduce the RI-ISI benefit in the change in risk sensitivity. For the sensitivity analysis, even though each sub-segment would result in the same or lower risk result as the segment that was evaluated, each sub-segment was conservatively assigned the same risk as the segment evaluated.

The conservative results of the change in risk sensitivity resulted in no new systems exceeding the acceptance criteria of WCAP Section 4.4.2. As a comparison to Table 3.10-1, "Comparison of CDF/LERF for Current Section XI and Risk-Informed ISI Programs and the Systems Which Contributed Significantly to the Change," in the March 1, 2002 submittal, the following table provides the results of the sensitivity.

CHANGE IN RISK SENSITIVITY CDF/LERF FOR CURRENT SECTION XI AND RISK-INFORMED ISI PROGRAMS FOR THE SYSTEMS WHICH SIGNIFICANTLY CONTRIBUTED TO THE RESULTS		
Case **(Systems Contributing ≥ 5% to Change)**	**Current Section XI**	**Risk-Informed**
CDF No Operator Action	1.21E-5	5.51E-6
Primary Coolant System (PCS)	4.34E-6	4.07E-6
Critical Service Water (CSW)	5.23E-6	5.63E-7
Chemical and Volume Control (CVC)	3.27E-7	3.34E-7
CDF with Operator Action	6.39E-6	4.63E-6
PCS	4.34E-6	4.07E-6
LERF No Operator Action	8.44E-9	2.86E-9
PCS	1.59E-9	1.49E-9
CSW	4.01E-9	2.87E-10
Shutdown Cooling System (SDC)	1.69E-9	6.77E-10
LERF with Operator Action	2.67E-9	2.11E-9
PCS	1.59E-9	1.49E-9
SDC	3.87E-10	2.90E-10

4. SUMMARY OF THE SUPPLEMENT

NMC is providing this supplement to the March 1, 2002 RI-ISI Program submittal, to address the NRC's concern that the proposed RI-ISI Program for Palisades contains a potential deviation from the approved WCAP methodology. NMC reviewed the March 1, 2002 submittal, the NRC RI-ISI audit results, the WCAP, and upon further discussion with the NRC Staff, determined that enhancements to the application of the WCAP methodology at Palisades were necessary to aid in the review and approval of the proposed RI-ISI Program. The enhancements to the application of the WCAP methodology at Palisades provide conservative results that address the NRC Staff concerns on the way NMC originally applied the WCAP methodology to the proposed RI-ISI Program. This supplement commits to additional piping weld inspections on high safety significant segments defined in the program.

The total number of inspections required in the Palisades RI-ISI Program include: inspections identified in the March 1, 2002 RI-ISI Program submittal; inspections for the 23 segments changed from LSS to HSS in the response to the NRC RAI dated August 8, 2002; and 48 additional inspections identified in the enhancements to HSS segments with multiple pipe sizes identified in this supplement.