April 3, 2006

Mr. Paul A. Harden
Site Vice President
Nuclear Management Company, LLC
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT — REQUEST FOR RELIEF FROM ASME CODE, SECTION XI, REQUIREMENTS FOR REPAIR OF PRESSURIZER NOZZLE PENETRATIONS (TAC NO. MC8170)

Dear Mr. Harden:

Your letter of August 11, 2005, as supplemented January 31, and March 13, 2006, requested relief from certain American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code) requirements at Palisades Nuclear Plant (PNP). The request for relief would allow an alternative repair for 120 PNP Alloy 600 pressurizer heater sleeve penetrations in lieu of the following ASME Code Section XI, requirements:

- paragraph IWB-2420, "Successive Inspections"
- subarticle IWA-3300, "Flaw Characterization"
- sub-subparagraph IWB-3142.4, "Acceptance by Analytical Evaluation"
- paragraph IWB-3420, "Characterization"

We have reviewed your proposed alternative to the ASME Code Section XI requirements for required flaw examinations and successive examinations for pressurizer heater sleeve penetrations. Based on our review, we conclude that granting relief pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i) and with NMC's regulatory commitments listed in Section 4.0 of the enclosed safety evaluation NMC's alternative repair, as stated in this relief request, will provide an acceptable level of quality and safety and is authorized for PNP for the remainder of the current 10-year inspection interval.

Please note that your letter of July 22, 2005, "Request for Relief from ASME Section XI Code Requirements for Repair of Pressurizer Nozzle Penetrations [Use of Code Case N-638 with three exceptions]," indicates that if pressurizer heater-sleeve penetration repair is necessary, NMC plans to perform ASME Code, Section III, design analysis.

Impact on License Renewal

Palisades' general corrosion assessment was for 40 and 60 years. The thermal-fatigue crack growth assessment was for 40 years. These assessments should be considered time-limited aging analyses within the scope of 10 CFR Part 50 when the repair becomes part of NMC's current licensing basis. If the repair is performed prior to the issuance of the renewed license, NMC must validate the assessments for 60 years or provide an aging management program in accordance with 10 CFR 54.21(b). If the repair is performed after the issuance of the extended license, the changes and assessments should be evaluated in accordance with 10 CFR 54.37(b).

Sincerely,

/RA/

L. Raghavan, Branch Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation

cc w/encl: See next page

Impact on License Renewal

Palisades' general corrosion assessment was for 40 and 60 years. The thermal-fatigue crack growth assessment was for 40 years. These assessments should be considered time-limited aging analyses within the scope of 10 CFR Part 50 when the repair becomes part of NMC's current licensing basis. If the repair is performed prior to the issuance of the renewed license, NMC must validate the assessments for 60 years or provide an aging management program in accordance with 10 CFR 54.21(b). If the repair is performed after the issuance of the extended license, the changes and assessments should be evaluated in accordance with 10 CFR 54.37(b).

Sincerely,

/RA/

L. Raghavan, Branch Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR AUTHORIZATION TO USE ALTERNATIVES TO ASME CODE, SECTION XI,

FOR REPAIR OF PRESSURIZER NOZZLE PENETRATIONS

NUCLEAR MANAGEMENT COMPANY

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

Nuclear Management Company, LLC's (NMC's) letter of August 11, 2005, as supplemented January 31, and March 13, 2006, requested relief from certain American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code) requirements at Palisades Nuclear Plant (PNP). The request for relief would allow an alternative repair for 120 PNP Alloy 600 pressurizer heater sleeve penetrations in lieu of the following ASME Code Section XI, requirements:

- paragraph IWB-2420, "Successive Inspections"
- subarticle IWA-3300, "Flaw Characterization"
- sub-subparagraph IWB-3142.4, "Acceptance by Analytical Evaluation"
- paragraph IWB-3420, "Characterization"

As an alternative, NMC proposes to assume the worst-case cracks in the Alloy 600 pressurizer nozzle base and weld material using the methodology in Topical Report (TR) WCAP-15973-P, Revision 01, "Low Alloy Steel Component Corrosion Analysis Supporting Small-Diameter Alloy 600/690 Nozzle Repair/Replacement Program." The Nuclear Regulatory Commission's (NRCs) letter of January 12, 2005, issued the final safety evaluation (SE) on WCAP-15973-P, Revision 01, (ADAMS Accession No. ML050180528) approving it to the extent possible under the limitations in the TR and the associated SE.

The SE defines the basis for acceptance of the TR. The conditions of the SE require licensees that propose to use the half-nozzle or mechanical nozzle seal assembly (MNSA) repairs, to submit to the NRC the required information contained in the TR as a relief request in accordance with Section 50.55a of Title 10 of the *Code of Federal Regulations* (10 CFR). The repair method that NMC will be employing is similar to the half-nozzle repair, in that a portion of the existing nozzle is removed and welding is performed on the pressurizer shell. The NMC repair will not replace the nozzle. Rather, NMC will install an Alloy 690 plug into the penetration, where a portion of the existing nozzle is removed, and then weld a pad over the Alloy 690 plug. This pad will become a part of the pressurizer pressure boundary.

2.0 REGULATORY EVALUATION

The inservice inspection (ISI) of ASME Code Class 1, 2, and 3 components in nuclear plants is to be performed in accordance with the ASME Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," and applicable edition and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The regulation at 10 CFR 50.55a(a)(3) states: "Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section, or portions thereof, may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that: (i) The proposed alternatives would provide an acceptable level of quality and safety, or (ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety." Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that ISI examination of components and system pressure tests conducted during the first 10-year interval, and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12-months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The current 10-year ISI interval for Palisades concludes on, or before, December 12, 2006, and the ISI ASME Code of record is the 1989 Edition with no Addenda. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to commission approval.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Requirements

ASME Code Section XI subarticle IWA-3300, sub-subparagraph IWB-3142.4, and paragraph IWB-3420, apply to any flaws discovered during ISI. Specifically:

(a) Subarticle IWA-3300 contains a requirement for flaw characterization.

(b) Sub-subparagraph IWB-3142.4 allows for analytical evaluation to demonstrate that a component is acceptable for continued service. It also requires that components found acceptable for continued service by analytical evaluation be subsequently examined in accordance with IWB-2420(b) and (c).

(c) Paragraph IWB-3420 requires the characterization of flaws in accordance with the rules of IWA-3300.

3.2 NMC's ASME Code Relief Request and Proposed Alternative

NMC proposed alternatives to the required flaw characterization (IWA-3300) and successive inspections (IWB-2420) requirements. In lieu of fully characterizing/sizing existing cracks that may be found, NMC assumed the worst-case cracks in the Alloy 600 base and weld material and used the methodology presented in WCAP-15973-P, Revision 01 for determining the following:

1. The overall general/crevice corrosion rate for the internal surfaces of the low-alloy or carbon steel materials, which will now be exposed to the primary coolant, and the amount of time the ferritic portions of the vessel or piping would be acceptable if corrosive wall thinning occurred.

2. The thermal fatigue crack growth life of existing flaws in the Alloy 600 nozzles and/or Alloy 82/182 weld material into the ferritic portion of the vessels or piping.

3. An acceptable method and basis for concluding that unacceptable growth of the existing flaw by stress corrosion into the vessel or piping is improbable.

NMC further evaluated the assumptions made to support this relief request using appropriate flaw evaluation rules of ASME Section XI, and determined that the results comply with ASME Code Section XI criteria for the expected 40-years of plant life. As a result, NMC also requested relief from the successive inspections required by IWB-2420.

3.3 Components for which Relief is Requested

This relief request applies to 120 PNP pressurizer heater sleeve penetrations classified as ASME Code Section XI, Class 1, Table IWB-2500-1 examination category B-E, "Pressure Retaining Partial Penetration Welds in Vessels," Item B4.20.

3.4 NMC's Basis for Proposed Alternative

3.4.1 Introduction

During fabrication of the pressurizer heater sleeve penetrations, Alloy 600 small-bore nozzles were welded to the interior of the pressurizer bottom head. Industry experience has shown that cracks may develop in the nozzle, or in the weld metal joining the nozzles to the pressurizer, and lead to primary coolant system leakage. The cracks are caused by primary water stress corrosion cracking (PWSCC).

The total removal of all Alloy 600 small-bore nozzles and weld metal would require accessing the interior surface of the pressurizer, and grinding out the attachment weld and any remaining nozzle material. The analysis in the TR has shown that any remnant cracks in the nozzle, the attachment weld, and the vessel carbon steel base metal following a repair will not affect structural integrity of the pressurizer or propagate through the primary coolant pressure boundary. There is no increase in the level of quality and safety as a result of removing the nozzle or the attachment weld, and therefore, NMC will not be removing the remnant sleeve or its attachment weld.

NMC proposed an alternative, as discussed below, for not performing flaw characterization or successive inspections, as required in the ASME Code, Section XI.

3.4.2 NMC's Basis for the Proposed Alternatives

Pursuant to 10 CFR 50.55a(a)(3)(i), NMC is proposing alternatives to the ASME Code flaw characterization (IWA-3300) and successive inspections (IWB-2420) requirements. In lieu of fully characterizing/sizing existing cracks that may be found, NMC assumed the worst-case cracks in the Alloy 600 base and weld material and used the methodology presented in WCAP-15973-P, Revision 01 for determining the following:

1. The overall general/crevice corrosion rate for the internal surfaces of the low-alloy or carbon steel materials, which will now be exposed to the primary coolant, and for calculating the amount of time the ferritic portions of the vessel or piping would be acceptable if corrosive wall thinning occurred.

2. The thermal fatigue crack growth life of existing flaws in the Alloy 600 nozzles and/or Alloy 82/182 weld material into the ferritic portion of the vessels or piping.

3. An acceptable method and basis for concluding that unacceptable growth of the existing flaw by stress corrosion into the vessel or piping is improbable.

NMC reviewed the methods and basis presented in the TR for the overall general/crevice corrosion rate, thermal fatigue crack growth life of existing flaws, and the basis for concluding that growth of the existing flaw by stress corrosion into the vessel or piping is improbable. NMC found that the methods and basis apply to the proposed pad repair of the pressurizer heater sleeve penetrations at PNP. NMC evaluated these assumptions using appropriate flaw evaluation rules of Section XI, and in lieu of performing successive inspections, NMC determined that the results comply with ASME Section XI criteria for the expected balance of plant life. Therefore, NMC determined that the proposed alternatives will provide an acceptable level of quality and safety.

NMC determined that the proposed alternatives will provide an acceptable level of quality and safety and are within the analysis boundaries provided in TR WCAP-15973-P, Revision 01, by addressing the requirements below set forth by NRC letter of January 12, 2005, "Final Safety Evaluation For Topical Report WCAP-15973-P, Revision 01."

3.4.2.1 General Corrosion Assessment

The staff's January 12, 2005, SE, indicates that licensees seeking to use the methods of Westinghouse TR WCAP-15973-P, Revision 01 will need to meet the requirements below in order to confirm that the ferritic portions of the vessels or piping within the scope of the TR will be acceptable for service throughout the licensed lives of their plants (40 years if the normal licensing basis plant life is used, or 60 years if the facility is expected to be approved for extension of the operating license).

NRC Requirement 1

Calculate the minimum-acceptable wall thinning thickness for the ferritic vessel or piping that will adjoin to the MNSA repair or half-nozzle repair. Section 2.4 of TR WCAP-15973-P, Revision 01, indicates that the maximum-allowable nozzle-bore hole size resulting from corrosion should be calculated based on: (1) the reduction in the effective weld shear area, and (2) the required area of reinforcement for the nozzle bore holes.

NMC Response

Attachment 1 of NMC's letter of July 22, 2005, "Request for Relief from ASME Section XI Code Requirements for Repair of Pressurizer Nozzle Penetrations [Use of Code Case N-638 with three exceptions]," described the proposed repair and inspection plan for PNP. The minimum acceptable wall thinning for the PNP bottom head is independent of the repair method. The more appropriate limiting parameter is the diameter of the heater sleeve penetration.

An analysis was performed by Westinghouse Electric Company (A-CEOG-9449-1242, "Evaluation of the Corrosion Allowance for Reinforcement and Effective Weld to Support Small Alloy 600 Nozzle Repairs," Revision 00, dated June 13, 2000) which calculated the limiting (allowable) diameter for pressurizer heater sleeve penetrations for PNP relative to (1) the reduction in the effective weld shear area, and (2) the required area of reinforcement for the nozzle bore holes for each type nozzle (and heater sleeve) in the pressurizer, primary coolant system piping and steam generator primary head. The limiting diameter is the more conservative of the two values. The limiting diameter for the PNP pressurizer heater penetration is 2.140 inches based on the reinforcement and effective weld area criteria.

NRC Requirement 2

Calculate the overall general corrosion rate for the ferritic materials based on the calculational methods in the TR, the general corrosion rates listed in the TR for normal operations, startup conditions (including hot standby conditions), and cold shutdown conditions, and the respective plant-specific times (in-percentage of total plant life) at each of the operating modes.

NMC Response

The assumptions in the TR analysis regarding times at each of the operation modes are as follows:

- Normal Operation: 88 percent
- Startup Condition: 2 percent
- Cold-Shutdown Condition: 10 percent

A review of the PNP operating history, as indicated in the Palisades Fuel Management Plan, indicates that the time at operational conditions has been significantly less than the assumed value of 88 percent. The ratio of effective full power days (EFPD) to days since the beginning of commercial operations indicates that the plant was at operating conditions for about 56 percent of the time from December 31, 1971, through November 17, 2004 (beginning of the current cycle). Several steam generator problems were the major contributors to the relatively

low percentage of time at operating conditions. These were resolved by replacing the original steam generators. The new steam generators entered service in March 1991. Since that time, PNP has been at operational conditions approximately 74.1 percent of the time, which are still less than the value assumed for the TR analysis. The operational times since steam generator replacement are most appropriate for calculating the plant-specific overall general corrosion rate for the ferritic materials required by Section 4.1 of WCAP-1 5973-P. Assuming 74.1 percent normal operations, 2 percent start-up conditions, and 23.9 percent cold shutdown conditions, the overall general corrosion rate (in mils per year, mpy) was calculated as follows:

Corrosion rate (CR) = 0.741 x 0.4 mpy + 0.02 x 19.0 mpy + 0.239 x 8.0 mpy
CR = 2.59 mpy (0.00259 in/yr)

NRC Requirement 3

Track the time at cold shutdown conditions to determine whether this time does not exceed the assumptions made in the analysis. If these assumptions are exceeded, the licensees shall provide a revised analysis to the NRC, and provide a discussion on whether volumetric inspection of the area is required.

NMC Response

As noted in the response to Condition 2 above, the time at cold shutdown conditions for PNP exceeds the assumptions made in the TR analysis. Since the cold shutdown assumptions were exceeded, a revised general corrosion rate has been calculated based on the plant-specific times at each of the operating modes.

At the present time, PNP has not completed any repairs to pressurizer heater sleeves. Thus, the ferritic material in the pressurizer bottom head has not been exposed to primary coolant and no corrosion has occurred. If PNP does complete pressurizer heater sleeve repairs in the future, NMC will track the percentage of plant time at normal, shut down, and start-up modes of operation to ensure that the corrosion rate calculated above is not exceeded. If the calculated corrosion rate is exceeded, NMC will provide a revised analysis to the NRC evaluating the effect of the increased corrosion rate on the analysis described below, including a discussion of whether volumetric inspection of the ferritic material is required at PNP.

NRC Requirement 4

Calculate the amount of general corrosion-based thinning for the vessels or piping over the life of the plant, as based on the overall general corrosion rate calculated in Step 2 and the thickness of the ferritic vessel or piping that will adjoin to the MNSA repair or half-nozzle repair.

NMC Response

The plant-specific corrosion rate calculated in response to condition 2 (2.59 mpy) was used to calculate the amount of general corrosion that could occur over the remaining plant life for the normal licensing basis (40 years) and for an additional 20 years, assuming that PNP is approved for an extension of the current operating license.

The analysis assumes that the earliest date at which a pressurizer heater sleeve repair will be implemented is the end of the current cycle of operation, estimated at March 19, 2006. The current license expires on March 24, 2011, which would provide a lifetime of 5.01 years for the current license for a repair, and a lifetime of 25.01 years, if PNP receives approval for extension of the operating license.

For the current license, metal loss (increase in the heater sleeve hole size) because of corrosion can be calculated by:

Metal loss = CR x remaining life
= 0.00259 in/year x 5.01 years = 0.013 inch (radially) or
= 0.026 inch (diametrically)

For the extended life, if approved, the corrosion (increase in hole size) can be calculated by:

Metal loss = CR x remaining life
= 0.00259 in/yr x 25.01 years = 0.065 inch (radially)
= 0.130 inch (diametrically)

NRC Requirement 5

Determine whether the vessel or piping is acceptable over the remaining life of the plant by comparing the worst case remaining wall thickness to the minimum acceptable wall thickness for the vessel or pipe.

NMC Response

A review of A-CEOG-9449-1242 indicates the initial sleeve penetration diameter was 1.173 inches. The final diameter of the heater sleeve penetration, as a result of general corrosion resulting from the exposure of the ferritic material to primary coolant, can be calculated as follows:

Final diameter = initial diameter + increase in diameter

For the current license, then, Final diameter = 1.173 in. + 0.026 in.= 1.199 in.

For the extended life, Final diameter = 1.173 in. + 0.130 in.= 1.303 in.

From condition 1, the limiting diameter for the PNP pressurizer heater penetration is 2.140 inches. Thus, the limiting diameter will not be exceeded over the remaining life of the plant.

3.4.2.2 Thermal Fatigue Crack Growth Assessment

The staff's January 12, 2005, SE indicates that licensees seeking to use the thermal fatigue crack growth assessment methods of Westinghouse TR WCAP-15973-P, Revision 01 will need to meet the requirements below.

NRC Requirement 1

The geometry of the leaking penetration is bounded by the corresponding penetration reported in Calculation Report CN-CI-02-71, Revision 01.

NMC Response

The geometry of the PNP pressurizer heater penetration is bounded by the configurations applied in the pressurizer heater penetration fatigue growth analysis of the Westinghouse Calculation Note CN-CI-02-71. The drawings listed in section 7.4.1 of CN-CI-02-71 are applicable for the pressurizer heater penetrations, the shell and the support skirt at PNP.

NRC Requirement 2

The plant-specific pressure and temperature profiles in the pressurizer water space for the limiting curves (cooldown curves) do not exceed the analyzed profiles shown in Figure 6-2 (a) of Calculation Report CN-CI-02-71, Revision 01, as stated in Section 3.2.3 of the TR SE.

NMC Response

The analyzed transient conditions described in Figure 6-2(a) of Calculation Note CN-CI-02-71 bound the pressure and temperature profiles of the PNP operation of the pressurizer. An evaluation of the CN-CI-02-71 described transients has been performed against the plant operating data and procedures. This evaluation is documented in a PNP engineering analysis, EA-A600-2004-01, and is included as Attachment 2 to the relief request.

NRC Requirement 3

The plant-specific Charpy USE data shows a USE value of at least 70 ft-lb to bound the USE value used in the analysis. If the plant-specific Charpy USE data does not exist, and the licensee plans to use Charpy USE data from other plants' pressurizers and hot-leg piping, then justification (e.g., based on statistical or lower bound analysis) has to be provided.

NMC Response

NMC did not use plant-specific Charpy test data to bound the USE value used in the analysis. Westinghouse Calculation Note CN-CI-02-71 applied a lower bound Charpy USE of 70 ft-lbs in the Elastic-Plastic Fracture Mechanics (EPFM) analysis of the pressurizer flaw analysis. The EPFM analysis was used to justify the effects of the large in-surge transients which do not pass the Linear Elastic Fracture Mechanics (LEFM) criteria.

The comparison of plant-specific data to the 70 ft-lbs USE value is not necessary for PNP. The PNP operation of the pressurizer results in less-severe transient conditions than those analyzed in CN-CI-02-71. Although the PNP water solid operation of the pressurizer practically eliminates the in-surge and the out-surge transients postulated in CN-CI-02-71, a plant-specific flaw fatigue growth analysis was performed. The analysis, provided as Attachment 2 to its letter of January 31, 2006, used a 220 degree F in-surge transient, in lieu of the 320 degree F in-surge transient applied in the generic analysis. The resultant final flaw sizes were found to be acceptable by the LEFM criteria. Therefore, EPFM analysis methodology used in the generic

flaw evaluation in CN-CI-02-71 was not required and not used in the plant-specific flaw evaluation. Therefore, the upper-shelf energy data for the pressurizer lower head is not required.

3.4.2.3 Stress Corrosion Crack Growth Assessment

The staff's January 12, 2005, SE indicates that licensees seeking to use the methods of Westinghouse TR WCAP-15973-P, Revision 01 to implement MNSA repairs or half-nozzle replacements may use the Westinghouse Owners Group's (WOG's) stress corrosion assessment as the bases for concluding that existing flaws in the weld metal will not grow by stress corrosion if they meet the requirements below.

NRC Requirement 1

Conduct appropriate plant chemistry reviews and demonstrate that a sufficient level of hydrogen overpressure has been implemented for the reactor coolant system (RCS), and that the contaminant concentrations in the reactor coolant have been typically maintained at levels below 10 parts per billion (ppb) for dissolved oxygen, 150 ppb for halide ions, and 150 ppb for sulfate ions.

NMC Response

NMC has conducted appropriate chemistry reviews and has concluded that there is a sufficient level of hydrogen overpressure in the primary coolant system (PCS). A PCS hydrogen overpressure of 215 cubic centimeters per kilogram (cc/kg) is established prior to reactor criticality (hard-hold point), and is maintained in a range of 25 to 50 cc/kg in Mode 1. In Mode 1, PCS hydrogen is a control parameter with Action Level 1 outside the range of 25 - 50 cc/kg, Action Level 2 less than 15 cc/kg, and Action Level 3 less than 5 cc/kg. Chemistry administrative control procedures do not allow critical reactor operation with the PCS hydrogen less than 15 cc/kg without immediate corrective action. NMC has reviewed contaminant concentrations in the PCS at PNP and has confirmed that the PCS dissolved oxygen, halide ions, and sulfate ions are within the criteria mentioned above.

NRC Requirement 2

During the outage in which the half-nozzle or MNSA repairs are scheduled to be implemented, licensees adopting the TR's stress corrosion crack growth arguments will need to review their plant-specific RCS coolant chemistry histories over the last two operating cycles for their plants, and confirm that these conditions have been met over the last two operating cycles.

NMC Response

If a pressurizer heater sleeve is repaired at PNP, NMC will perform a review of the PCS chemistry histories over the last two operating cycles to confirm that the conditions required by the TR have been met.

3.4.2.4 Other Considerations

In addition to general corrosion, thermal fatigue crack growth, and stress corrosion issues discussed previously in sections 3.4.2.1, 3.4.2.2 and 3.4.2.3, the staff's January 12, 2005, SE, indicates that licensees seeking to use the methods of Westinghouse TR WCAP-15973-P, Revision 01 will need to meet the requirements below.

NRC Requirement 1

Licensees using the MNSA repairs as a permanent repair shall resolve the NRC concerns addressed in the NRC's letter of December 8, 2003, from H. Berkow to H. Sepp (ADAMS Accession No. ML033440037) concerning the analysis of the pressure boundary components to which the MNSA is attached and an augmented ISI program.

NMC Response

NMC is not currently planning on using the MNSA repair technique for the pressurizer repair.

NRC Requirement 2

Currently, half-nozzle and MNSA repairs are considered alternatives to the ASME Code, Section XI. Therefore, licensees proposing to use the half-nozzle and MNSA repairs shall submit the required information contained in TR WCAP-15973-P, Revision 01 to the NRC as a relief request in accordance with 10 CFR 50.55a.

NMC Response

This letter provides NMC's response to the conditions of the SE as a relief request in accordance with 10 CFR 50.55a.

3.7 Regulatory Commitments

NMC's letter of August 11, 2005, contains the following two new commitments and no revisions to existing commitments:

1. If a pressurizer heater sleeve is repaired at PNP, NMC will track the percentage of plant time at normal, shut down and start-up modes of operation to ensure that the corrosion rate calculated is not exceeded. If the calculated corrosion rate is exceeded, NMC will provide a revised analysis to the NRC evaluating the effect of the increased corrosion rate on the analysis, including a discussion of whether volumetric inspection of the ferritic material is required at PNP.

2. If a pressurizer heater sleeve is repaired at PNP, NMC will perform a review of the PCS chemistry histories, over the last two operating cycles, to confirm that the conditions required by WCAP-15973-P, Revision 01 have been met.

3.8 Staff Evaluation

This request pertains to potential repairs of the PNP Alloy 600 pressurizer heater sleeve penetrations. The repair method that NMC will be employing is similar to the half-nozzle repair, in that a portion of the existing nozzle is removed, and welding is performed on the pressurizer shell. The NMC repair will not replace the nozzle. NMC will install an Alloy 690 plug into the penetration where a portion of the existing nozzle is removed, and then weld a pad over the Alloy 690 plug. This pad will become a part of the pressurizer pressure boundary. The NRC considers this action by NMC to be a proactive approach to address PWSCC susceptibility of these Alloy 600 components in the RCS.

NMC is requesting relief from IWA-3300, IWB-2420, IWB-3142.4, and IWB-3142.4 of ASME Code, Section XI, 1989 Edition, with no Addenda. NMC's alternative is to not fully characterize/size the existing flaws, but rather assume a worst-case flaw in the Alloy 600 base and weld material and use the methodology presented in Westinghouse TR WCAP-15973-P, Revision 01, to determine the items below.

1. The overall general/crevice corrosion rate for the internal surfaces of the low-alloy or carbon steel materials that will now be exposed to the reactor coolant, and the amount of time the ferritic portions of the vessel would be acceptable if corrosive wall thinning had occurred.

2. The thermal fatigue crack growth life of existing flaws in the Alloy 600 nozzles and/or Alloy 82/182 weld material into the ferritic portion of the vessels or piping.

3. Acceptable bases and arguments for concluding that unacceptable growth of the existing flaw by stress corrosion into the vessel or piping is improbable.

In a letter from the NRC to the WOG dated January 12, 2005, the NRC provided its final SE for the TR WCAP-15973-P, Revision 01. The NRC staff's assessment of TR WCAP-15973-P, Revision 01, indicated that the WOG's methods and analysis in the TR were generally acceptable. Specifically, the staff determined that TR WCAP-15973-P, Revision 01, provided sufficient basis to accomplish the above objectives with respect to implementing the half-nozzle repair. The NRC staff found that licensees could use the methods of the TR as a basis provided that answers to several plant-specific questions were submitted to the NRC for review. These questions were in the areas of general corrosion assessment, thermal fatigue crack growth assessment, stress corrosion cracking growth assessment, and a few other considerations. Through NMC's relief request, NMC provided the required responses to these questions as detailed in Section 3.4 above.

3.8.1 General Corrosion Assessment

In the area of general corrosion assessment, the NRC staff finds NMC's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. The limiting diameter for the PNP pressurizer heater penetration is 2.140 inches, based on the reinforcement and effective weld area criteria. NMC provided responses to staff's request for additional information (RAI) in a letter dated January 31, 2006. In response to RAI 4.1.b.3, NMC described the method of calculating the limiting diameter based on reinforcement and effective weld area criteria, as follows:

> The reduction in the effective weld shear area was first evaluated. The J-groove weld of the nozzle repair must be able to withstand the internal pressure on the diameter of the corroded borehole. The strength of the weld was examined, then the allowable diameter, D_c, was calculated for a maximum pressure of P=3.125 [thousands of pounds per square inch], ksi. The allowable shear stress for the J-groove weld is 0.6 S_m (design stress intensity) per paragraph NB-3227.2(a) of Section III of the ASME Code. Next, the maximum allowable borehole diameter was determined based on the required area of reinforcement. The [ASME] Code requirements for reinforcement of openings per paragraphs NB-3332, NB-3334, and NB-3643.3(c)(1)(c) of Section III of the ASME Code were used.
>
> The minimum, limiting allowable bore diameter, D_{lim}, was conservatively selected to be the smaller of the two diameter values calculated above.

Since the limiting diameter was calculated using ASME Code criteria, the allowable values are adequate for determining the impact of corrosion.

The overall general corrosion rate was calculated for PNP to be 2.59 mpy in accordance with the methodology of TR WCAP-15973-P, Revision 01, considering plant-specific operating history. NMC has committed to tracking the time at cold shutdown conditions to verify that the corrosion rate is not exceeded if the repairs are installed.

The initial diameter of the penetration bore hole was 1.173 inches. In response to RAI 4.1.c, NMC indicated that this value is the nominal counter bore (spot face) on the outer diameter of the pressurizer bottom head. The minimum and maximum sleeve penetration values for the PNP are 1.158 inches and 1.160 inches, respectively. Thus, the use of 1.173 for bore hole diameter would be conservative. If PNP implements a repair at the next scheduled outage, the penetration diameter over the remaining 40-year license was calculated to increase to 1.199 inches, and to increase to 1.303 inches for a 60-year license as a result of general corrosion. Since the calculated bore size resulting from corrosion for both a 40-year and 60-year licensed life is less than the limiting allowable bore diameter, NMC's analysis indicates that general corrosion should not impact the integrity of the proposed weld repair.

Additional design information was provided in a letter dated July 22, 2005. In this letter, NMC indicated that if a repair is necessary, NMC plans to perform the ASME Code Section III design analysis. NMC is not requesting relief from any Section III requirements. Therefore, the structural and leakage integrity of the primary system pressure boundary would be maintained by the repaired heater sleeve design.

3.8.2 Thermal Fatigue Crack Growth Assessment

NMC's letter of August 11, 2005, indicates that although the PNP water-solid operation of the pressurizer practically eliminates the in-surge and out-surge transients postulated in CN-CI-02-71, a plant-specific flaw fatigue growth analysis was performed. The analysis used a 220 degree F in-surge transient in lieu of the 320 degree F in-surge transient applied in the generic analysis. NMC provided responses to staff's RAI in letter dated January 31, 2006. In response to RAI 4.2, NMC provided the results from the PNP plant-specific flaw fatigue growth analysis. The PNP plant-specific flaw fatigue growth analysis was performed using LEFM and used the

methodology documented in CN-CI-02-71, Revision 1. CN-CI-02-71, Revision 1 was reviewed in the staff's SE on TR WCAP-15973-P, Revision 01.

In NMC's letter of March 13, 2006, it indicated that the allowable flaw size is based on criteria in paragraph IWB-3612, "Acceptance Criteria Based on Applied Stress Intensity Factor," in Section XI of the ASME Code and the primary stress limits in Article NB-3000, "Design," in Section III of the ASME Code. The allowable stress intensities at the final crack size in tables in Sections 3.4 and 3.5 of WCAP-15973-P, Revision 01, are based on criteria in paragraph IWB-3612 of Section XI of the ASME Code. The fatigue crack assessment was for 40 years of operation. The PNP plant-specific flaw fatigue growth analysis indicates that the total crack growth for the PNP geometry and transient conditions are relatively low and compare favorably to their allowable crack sizes. In addition, at the end of the 500 heatup and cooldown cycles and after the 220 degree F insurges, there remains significant margin to the allowable crack tip stress intensity factor.

In response to RAI 4.2, NMC compared the reference temperature, RT_{NDT}, value of the bottom head plates used to fabricate the PNP pressurizer to the RT_{NDT} value used in the PNP plant-specific flaw fatigue growth analysis. The RT_{NDT} for the plates were determined from plate specific Charpy impact test data and drop weight test data. The test data was evaluated in accordance with a staff methodology for converting the data into RT_{NDT} values. The RT_{NDT} value used in the PNP plant-specific flaw fatigue growth analysis was conservative relative to the RT_{NDT} values of the bottom head plates. This comparison indicates that the material properties used in the PNP plant-specific flaw fatigue growth analysis conservatively represent the PNP pressurizer bottom plate.

In the area of thermal fatigue crack growth assessment, the NRC staff finds NMC's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. NMC provided a plant-specific calculation using PNP geometry which shows sufficient margin of the final flaw size and the allowable axial flaw sizes of TR WCAP-15973-P, Revision 01, for 40 years of operation. The analysis also shows sufficient margin for the stress intensities at the final crack size at the end of 40 years of operation. The plant-specific pressure and temperature profiles bound the analyzed transient conditions in Figure 6-2(a) of report CN-CI-02-71, Revision 1. The plant-specific Charpy USE data was not applicable because NMC used a LEFM methodology. The RT_{NDT} value used in the PNP plant-specific flaw fatigue growth analysis was conservative relative to the RT_{NDT} values of the bottom head plates. Therefore, in the area of thermal fatigue crack growth assessment, the NRC staff finds NMC's proposed alternative acceptable.

3.8.3 <u>Stress Corrosion Crack Growth Assessment</u>

The staff's SE for TR WCAP-15973-P, Revision 01, indicates that licensees seeking to implement MNSA repairs or half-nozzle repairs may use the WOG's stress corrosion assessment as the bases for concluding that existing flaws in the weld metal will not grow by stress corrosion if they conduct appropriate plant chemistry reviews. These reviews must demonstrate that a sufficient level of hydrogen overpressure has been implemented for the RCS, and that the oxygen and halide/sulfate concentrations in the reactor coolant have been typically maintained at levels below 10 ppb and 150 ppb, respectively. During the outage in which the half-nozzle or MNSA repairs are scheduled to be implemented, licensees adopting

the TR's stress corrosion crack growth arguments will need to review their plant-specific RCS coolant chemistry histories over the last two operating cycles for their plants, and confirm that these conditions have been met over the last two operating cycles.

NMC's letter of August 11, 2005, provided the controls and concentration limits on hydrogen over pressure. In response to RAI 4.3, NMC confirmed that the PNP chemistry history over fuel cycle 16 and 17 met the concentration limits on hydrogen over pressure, and dissolved oxygen, halides and sulfate concentrations discussed in the previous paragraph. In the area of stress corrosion cracking growth assessment, the NRC staff finds NMC's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. In addition, NMC committed to perform a review of the PNP primary system chemistry over the prior two operating cycles when a pressurizer heater sleeve is repaired.

3.8.4 Other Considerations

In the area of other considerations, the NRC staff finds NMC's responses met the requirements of the NRC's final SE for TR WCAP-15973-P, Revision 01. NMC provided the information required by the NRC final SE for TR WCAP-15973-P, Revision 01, as noted above, as a relief request. The information provided was sufficient to meet the requirements for PNP to use TR WCAP-15973-P, Revision 01, as a basis for a relief request. Therefore, in the area of other considerations, the NRC staff finds NMC's proposed alternative acceptable.

The NRC staff's review of NMC's responses in the areas of general corrosion assessment, thermal fatigue crack growth assessment, stress corrosion crack growth assessment, and other considerations, supports NMC's use of the TR WCAP-15973-P, Revision 01, as a basis for this relief request. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), and with the regulatory commitments listed in Section 2.0 above, the NRC staff finds this relief request will provide an acceptable level of quality and safety for PNP for the remainder of the current 10-year inspection interval, which will conclude on or before December 12, 2006.

4.0 CONCLUSION

The NRC staff has reviewed NMC's proposed relief request as an alternative to the ASME Code, Section XI, requirements for required flaw examinations and successive for 120 PNP pressurizer heater sleeve penetrations. Based on the NRC staff's review of NMC's proposed justification, the NRC staff concludes that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), and with NMC's regulatory commitments listed in Section 2.0 above, NMC's alternative repair, as stated in this relief request, will provide an acceptable level of quality and safety and is authorized for PNP for the remainder of the current 10-year inspection interval.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

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