September 4, 2007

Mr. Michael Balduzzi
Sr. Vice President, Regional Operations NE
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: PALISADES NUCLEAR PLANT - REQUEST FOR AUTHORIZATION TO EXTEND THE THIRD INSERVICE INSPECTION INTERVAL FOR REACTOR VESSEL WELD EXAMINATION (TAC NO. MD3059)

Dear Mr. Balduzzi:

By letter dated September 15, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062650255), as supplemented by letter dated May 31, 2007 (ADAMS Accession No. ML071630250), Nuclear Management Company, LLC (the licensee, at the time of submittal), submitted a request for authorization to extend the third 10-year inservice inspection (ISI) interval for reactor vessel weld examinations. Specifically, pursuant to Title 10 of the *Code of Federal Regulations*, (10 CFR) Section 50.55a(a)(3)(i), the licensee requested approval for the use of an alternative to the requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code*, Section XI, Paragraph IWB-2412, Inspection Program B, for the Palisades Nuclear Plant (PNP). Entergy Nuclear Operations, Inc. has since become the current licensee, following a license transfer that occurred on April 11, 2007.

The Nuclear Regulatory Commission (NRC) staff has completed its review of the subject request for authorization of an alternative. As documented in the enclosed Safety Evaluation, the NRC staff concludes that the proposed alternative is justified on the basis that it would provide an acceptable level of quality and safety. Therefore, the NRC staff authorizes the proposed alternative pursuant to 10 CFR 50.55a(a)(3)(i) for the third 10-year ISI interval at PNP. The proposed alternative is authorized until the end of spring 2009 refueling outage.

Sincerely,

/RA/

Travis L. Tate, Acting 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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Palisades Plant

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR AUTHORIZATION TO EXTEND THE THIRD

AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE,

SECTION XI, 10-YEAR INTERVAL FOR REACTOR VESSEL WELD EXAMINATION

PALISADES NUCLEAR PLANT

ENTERGY NUCLEAR OPERATIONS, INC.

DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated September 15, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062650255), as supplemented by letter dated May 31, 2007 (ADAMS Accession No. ML071630250), Nuclear Management Company, LLC, (NMC, the licensee, at the time of submittal), submitted a request for authorization to extend the inspection interval for performing reactor vessel (RV) weld examinations beyond the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code) allowable time frame. The RV weld inservice inspection (ISI) consists of ultrasonic examinations intended to discover flaws or other discontinuities. Periodic examination is performed to determine whether flaws have initiated, whether pre-existing flaws have extended, or whether pre-existing flaws that may have been missed using older nondestructive examination technology are discernable using more advanced technology. The examinations are required to be performed at least once during every ISI program interval, as defined in Section XI of the ASME Code.

Entergy Nuclear Operations, Inc. has since become the current licensee, following a license transfer on April 11, 2007.

2.0 REGULATORY EVALUATION

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a, licensees are required to perform periodic inspections of components. Section 50.55a(g) of 10 CFR requires licensees to perform surveillance testing in accordance with the ASME Code, Section XI requirements. The code of record for Palisades Nuclear Plant (PNP) for the third 10-year ISI interval, which began on May 12, 1995, is the 1989 Edition. Subsection IWA-2430(a) of this edition of the ASME Code states: "The inservice examinations and system pressure tests required by IWB, IWC, IWD, and IWE shall be completed during each of the inspection intervals for the service lifetime of the power unit. The inspections shall be performed in accordance with the schedules of Inspection Program A of IWA-2431, or optionally Inspection Program B of IWA-2432." PNP is using Inspection Program B.

Section XI, IWA-2430(d) states, "For components inspected under Program B, each of the inspection intervals may be extended or decreased by as much as 1 year. Adjustments shall not cause successive intervals to be altered by more than 1 year from the original pattern of the intervals." The licensee has taken advantage of this paragraph for an extension of 1 year. Section XI, IWA-2430 (e) states, " . . . for power units that are out of service continuously for 6 months or more, the inspection interval during which the outage occurred may be extended for a period equivalent to the outage and the original pattern of intervals extended accordingly for successive intervals." The licensee has taken advantage of this paragraph for a 215-day extension due to an extended maintenance outage in 2001. As a result of the ASME Code-allowed extensions, the third inspection interval ended on December 12, 2006.

Section 10 CFR 50.55a(a)(3)(i) states, in part, that the Director of the Office of Nuclear Reactor Regulation (NRR) may authorize alternatives to the requirements of 10 CFR 50.55a(g). In order for the Director of NRR to authorize an alternative in accordance with 10 CFR 50.55(a)(3)(i), the Nuclear Regulatory Commission (NRC) staff must find that the licensee has demonstrated that the proposed alternative provides an acceptable level of quality and safety.

By letters dated November 29, 2005, and December 14, 2005, the NRC staff approved the licensee's relief request to extend the third ISI interval for PNP's RV weld examinations for one refueling cycle beyond the 11 years, 215 days permitted by the ASME Code. PNP's refueling cycles last approximately 18 months, but outage scheduling is such that the NRC staff's approval is valid through the end of the fall 2007 refueling outage. In this current submittal, the licensee requests to extend the third ISI interval for PNP's RV weld examinations for two refueling cycles beyond the 11 years, 215 days permitted by the ASME Code. The current proposed Relief Request would be valid until the end of spring 2009 refueling outage. This request does not affect the inspection requirements of the PNP's fourth 10-year ISI interval which began on December 13, 2006.

3.0 TECHNICAL EVALUATION

3.1 Systems/Components for Which Relief Is Requested

The affected component is the PNP RV. The following ASME Code, Section XI, examination categories and item numbers cover the RV:

Examination Category	Item Number	Description
B-A	B1.11	Circumferential Shell Weld
B-A	B1.12	Longitudinal Shell Welds
B-A	B1.21	Circumferential Head Weld
B-A	B1.22	Meridional Head Weld
B-A	B1.30	Shell-to-Flange Weld
B-D	B3.90	Nozzle-to-Vessel Welds
B-D	B3.100	Nozzle Inner Radius Areas
B-J*	B9.11	Circumferential Welds in Piping (Only for the RV inlet and outlet nozzle to piping welds)

*The B-J category welds are currently included in the risk-informed inservice inspection program as defense-in-depth exams under the augmented inspection program. For the B-J category welds, relief is granted only for the RV inlet and outlet nozzle-to-pipe welds.

These examination categories and item numbers are from IWB-2500 and Table IWB-2500-1 of the ASME Code, Section XI and were provided by the licensee as part of the submittal.

3.2 Basis for Relief

The licensee provided a qualitative assessment of the risk of RV failure. The assessment included a description of previous plant-specific RV ISI history, a description of fleet wide RV ISI history, a discussion of degradation mechanisms that are known or expected to be applicable to the locations that are the subject of the proposed alternative, a discussion regarding the material condition of the welds (including a discussion about neutron embrittlement), and a review of events that could challenge hypothetical flaws or discontinuities in the welds.

The licensee indicates the Category B-A, B-D and B-J welds have been examined twice previously. Those examinations achieved acceptable coverage, and no indications of flaw propagation were found. The licensee concludes that examinations were of sufficient quality to detect any significant flaws that would challenge RV integrity.

The licensee describes results of ISI examinations at 14 plants representing 301 total years of service, including plants fabricated by various vendors. No reportable indications were discovered at that group of plants. The licensee notes that studies by Pacific Northwest National Laboratory (PNNL) indicate that surface-breaking flaws are unlikely to extend through multiple layers of cladding. The PNP RV is constructed with multi-pass welding and, therefore, has a low probability of containing through-cladding surface-breaking flaws.

Finally, the licensee notes that all pressurized-water reactor (PWR) plants, except one, have performed at least one ISI, including the subject examinations, and that no surface-breaking or near surface flaws of any significance have been found.

The licensee identified fatigue as the only operable degradation mechanism for these welds and indicated the fatigue usage factor is very low. The licensee identified the cooldown transient as the most challenging loading sequence. Since approximately only one additional cooldown transient is anticipated during the extension period, the licensee concludes that any hypothetical fatigue crack growth would be inherently small.

The licensee noted that the PNP RV weld material is below, and will remain below, the pressurized thermal shock (PTS) screening criteria (according to 10 CFR 50.61) during the extension period. The licensee indicates that its operating procedures, low leakage cores, and heating of the safety injection water provide additional margin with respect to PTS beyond the margin assumed in the analyses used to develop the requirements in 10 CFR 50.61.

The licensee indicated that, from a loading perspective, the most severe operational challenge to RV integrity is due to PTS events. The licensee referred to the frequency and severity of PTS events developed for PNP in the NRC's March 3, 2005 Letter Report, "Palisades Pressurized Thermal Shock (PTS) Probabilistic Risk Assessment," (ADAMS Accession No. ML042880473). The licensee stated that the PNP probabilistic risk assessment (PRA) staff developed the analyses documented in this Letter Report. The analyses defined the sequence of events that are likely to produce a PTS event and the frequency with which such events can be expected to occur. The results of the PRA were used in NUREG-1806, "Technical Basis for Revision of the Pressurized Thermal Shock (PTS) Screening Limit in the PTS Rule (10 CFR 50.61): Summary Report" (ADAMS Accession No. ML061580318). The licensee identified the three sequences that contributed the greatest to the through wall cracking frequency (TWCF - a precursor to RV failure). The licensee referred to its October 11, 2005, submittal that described the measures in place to mitigate these sequences and concluded that the likelihood of having a PTS sequence that could challenge the integrity of the RV is acceptably small.

The licensee noted that no Alloy 600, 82 or 182 materials are present in any of these welds or adjacent base materials addressed by the subject request for an alternative. On the basis that there is no active aging degradation in the subject welds (categories-B-A, B-D, and B-J), the industry intends to extend the ISI interval from 10 to 20 years. To justify this inspection interval, the ASME Section XI Code Committee developed a Code Case N-691, "Application of Risk-Informed Insights to Increase the Inspection Interval for Pressurized Water Reactor Vessels," which is currently being reviewed by the NRC staff. The licensee's proposed Relief Request to defer the examination of the subject welds by one additional refuel cycle is intended to provide time for the NRC staff to complete its review. Upon the completion of the NRC staff's review and approval of the pending Relief Request, the licensee would submit a separate Relief Request to extend current 10 year ISI interval to 20 years. Based on the aforementioned technical bases, the licensee concludes that operation of the RV for an additional cycle, without performing the ISI examination of the subject welds, would not significantly increase the risk of flaw growth due to fatigue or to RV failure due to PTS.

3.3 NRC Staff Evaluation

ISI of RV welds helps to ensure structural integrity by identifying flaw growth before such flaws become large enough to represent challenges to pressure boundary integrity. The licensee provided a summary of prior examinations performed on the RV welds. All of the subject welds have been examined and no indications of flaw propagation have been found. Although ultrasonic examination technology has improved over the past decades, the geometry and

materials involved in RV weld examinations are such that these examinations have not been particularly challenging from an inspection technology perspective. Therefore, the NRC staff agrees with the licensee's qualitative assessment that the prior examinations were of sufficient quality to identify any significant flaws that would challenge RV integrity.

The licensee discussed the population of all PWRs and indicated that no surface-breaking flaws had been discovered; and furthermore, for a population of 14 plants that were reviewed in detail, no reportable indications were identified in any of the RV welds. The licensee also noted, referencing NUREG/CR-6471, "Characterization of Flaws in U.S. Reactor Pressure Vessels," that large flaws are not generally expected. The NRC staff concludes that the fleet ISI experience, and the ISI experience specific to PNP, are consistent with the PNNL evaluations: no significant flaws are expected. Furthermore, the NRC staff agrees that the two-layer cladding process used during fabrication of the PNP RV results in a low probability that a surface-breaking flaw could extend through the cladding to either the manganese-molybdenum RV plate or weld material.

The licensee indicates that fatigue is the only operative mechanism that could have caused flaws to either initiate or grow in the welds during the period since the previous inspection. The NRC staff concludes that corrosion, stress corrosion cracking and other forms of degradation due to weld material interaction with the chemical environment are not active degradation mechanisms for the RV welds. This is because the RV plates and welds are separated from the reactor coolant by a layer of corrosion resistant cladding. Even if the cladding was breached (for example due to an original fabrication flaw), the coolant water chemistry is controlled such that oxygen and other aggressive contaminants are maintained at very low levels such that the coolant is not aggressive to the ferritic material. Furthermore, the welds have not been subjected to a history of abnormal operation loading events, so mechanical overload has not been an active flaw initiation or propagation mechanism. Therefore, the NRC staff agrees with the conclusion that fatigue is the only likely operative mechanism that could have created or propagated flaws since the date the previous ISI examinations were performed.

The licensee indicated that the usage factor for these welds will be much lower than 1.0, after 40 projected years of operation, and that the most severe fatigue transient would be the cooldown. The NRC staff agrees that any flaw growth due to normal operational transients during the period since the last ISI examination would likely to be very minimal.

The licensee provided the unirradiated nil ductility transition reference temperature ($RT_{NDT(u)}$) values for each of the RV beltline materials and provided the PTS reference temperature (RT_{PTS}) values to permit assessment of the effects of neutron irradiation. The licensee noted that the RT_{PTS} value for each RV material will remain below the screening criteria of 270 °F (of 10 CFR 50.61) for the remaining period of its original license. The NRC staff had previously reviewed and approved these calculations as part of its review of PNP's response to Generic Letter 92-01, "Reactor Vessel Structural Integrity." Since the materials will remain below the screening criteria during the next refueling cycle, the probability of brittle fracture is acceptably low. The analyses that supported the development of 10 CFR 50.61 included assumptions about the size, number, and distribution of hypothetical flaws that bound the sizes, number, and distribution identified by PNP during its previous ISI examinations of the RV welds (no reportable flaws). Therefore, the NRC staff concludes that current compliance with 10 CFR 50.61 is sufficient to demonstrate that the probability of RV failure due to PTS is adequately low.

The NRC staff considered the analyses and PTS sequence frequency for PNP that is reported in the NRC's March 3, 2005, Letter Report. The NRC letter report documents the frequency and severity of PTS transients for PNP and is discussed in Section 3.2 of this evaluation. The support by the PNP staff during the development of the PTS sequence frequencies provides confidence that aspects of the analysis that relied on plant-specific features are appropriately included in the evaluation and the results. The PTS analysis reported in NUREG-1806 combine the PTS frequency with the likelihood of susceptible cracks in the reactor vessel. The results reported in Chapter 8 of NUREG-1806 indicate that at the end of PNP's extended lifetime (i.e., 60 years), the TWCF is not expected to exceed 2.0E-8/year. The frequency of the potential PTS sequences is not affected by the proposed extension of the RV weld inspection interval. The NUREG-1806 evaluation concluded that flaws are not expected to grow and therefore does not model RV inspections as a mechanism that decreases TWCF. Therefore, the NRC staff concludes that the relatively short extension requested by PNP coupled with the very low TWCF estimate provides confidence that any increase in risk during the extended interval will be substantially less than the Regulatory Guide 1.174, "An Approach for using Probabilistic Risk Assessment in Risk-Informed Decision on Plant-Specific Changes to the Licensing Basis," guidelines for acceptable increases in risk.

The NRC staff has reviewed the licensee's evaluation and makes the following conclusions:

- Previous RV ISI results were of sufficient quality to provide useful results.

- The previous ISI examinations did not identify any reportable indications or any indications requiring monitoring.

- The RV welds are not subjected to stresses or corrosive conditions that would create new flaws or cause old flaws to grow.

- Industry experience with ISI examinations of similar welds has yielded similar results: there are no known significant RV flaws.

- The most severe degradation mode that is expected to be operative is fatigue, and the most severe operational event with respect to fatigue is cooldown, which is an infrequent evolution. Therefore, growth of flaws due to fatigue would be minimal during the period since the previous ISI examination and would be very small during the proposed extension period.

- The RV material has sufficient toughness to be acceptable with respect to PTS, as determined by the licensee's compliance with the requirements of 10 CFR 50.61.
- The likelihood of a severe PTS event occurring during the proposed extension period that could challenge flaws that might exist is low.

In summary, the NRC staff concurs with the licensees qualitative assessment that their RV welds have a low likelihood of having significant flaws and that there is a low likelihood of experiencing a severe PTS event during the proposed extension period. The NRC staff finds that the risk associated with the two-cycle extension of the examination interval is sufficiently small that it need not be quantified to support the conclusion that this alternative continues to provide an acceptable level of quality and safety. Operation of the RV for an additional cycle without performing the ISI examination of the subject welds would not significantly increase the risk of flaw growth due to fatigue or to RV failure due to PTS.

4.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternative provides reasonable assurance of an adequate level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the extension of the third 10-year ISI interval, not to exceed the end of the spring 2009 refueling outage, to complete the PNP RV examinations.

All other requirements of the ASME Code for which relief has not been specifically requested remain applicable including third party review by the Authorized Nuclear Inservice Inspector.

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