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June 17, 2008

GL 2004-02

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

Request for Extension of Completion Date for Corrective Actions Required by Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors"

Dear Sir or Madam:

This letter requests an extension for the commitment to complete actions to resolve Generic Safety Issue (GSI)-191 at Palisades Nuclear Plant (PNP) by June 30, 2008.

By letter dated December 21, 2007, the Nuclear Regulatory Commission approved an extension request for Entergy Nuclear Operations, Inc. (ENO) to complete corrective actions at PNP required to achieve compliance with Generic Letter (GL) 2004-02. The approval granted ENO an extension to June 30, 2008, to complete chemical effects testing, debris transport analysis and testing, ex-vessel downstream effects evaluation and in-vessel effects evaluations.

However, in May 2008, ENO identified issues during head loss and chemical effects testing that require additional testing and evaluation. As a result, ENO has not completed actions to fully address the strainer head loss and chemical effects testing results in addition to the strainer downstream effects. The outstanding items are:

- Complete the plant specific in-vessel downstream effects evaluation per WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid."
- Complete the revision to the plant specific ex-vessel downstream effects evaluation to address WCAP-16406-P, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," Revision 1.

- Complete strainer head loss and chemical effects testing and evaluation of test results.
- Determine whether hardware and/or procedural modifications are needed, as a result of the chemical effects testing and evaluation, and implement modification, if required.

Considering the above, ENO requests an extension to the completion date for the completion of corrective actions required by GL 2004-02 for PNP from June 30, 2008, to December 31, 2008, provided no plant hardware modification is required. This would allow ENO time to complete the strainer head loss and chemical effects testing, receive the vendors' test reports for head loss and chemical effects testing, complete the evaluation of the downstream effects, and determine if plant hardware or procedure modification is required. Should hardware modification be necessary, it will be implemented prior to restart from the 2009 refueling outage.

The basis for the proposed extension is provided in Enclosure 1. ENO requests approval of this extension request by June 30, 2008.

Summary of Commitments

This letter revises two existing commitments.

Commitment made by letter dated December 3, 2007:

ENO will complete actions to resolve GSI-191 at PNP by June 30, 2008.

Revised commitment:

ENO will complete actions to resolve GSI-191 at PNP by December 31, 2008, provided no hardware modification is required. If plant hardware modification is required, then ENO will complete actions to resolve GSI-191 prior to restart from the 2009 refueling outage.

Commitment made by letter dated February 27, 2008:

Following actions to resolve GSI-191, ENO will submit a follow-up to GL 2004-02 supplemental response within 90 days of completion of strainer testing.

Revised commitment:

Following actions to resolve GSI-191, ENO will submit a follow-up to GL 2004-02 supplemental response by February 27, 2009, provided no hardware modification is required, or 60 days following restart from the 2009 refueling outage if modification is required.

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I declare under penalty of perjury that the foregoing is true and correct. Executed on June 17, 2008.

Christopher J. Schwarz *Kevin for CJSchwarz*
Site Vice President
Palisades Nuclear Plant

Enclosure

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

ENCLOSURE 1
REQUEST FOR EXTENSION OF COMPLETION DATE FOR CORRECTIVE ACTIONS
REQUIRED BY GENERIC LETTER 2004-02

1.0 Background

Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," (Reference 1), was issued on September 13, 2004. The NRC requested that licensees perform a mechanistic evaluation of the potential for the adverse effects of post-accident debris blockage and operation with debris-laden fluids to impede or prevent the recirculation functions of the emergency core cooling system (ECCS) and containment spray system (CSS) following all postulated accidents for which these systems are required. By letters dated August 25, 2005 (Reference 2), May 12, 2006 (Reference 3), and July 18, 2006 (Reference 4), Nuclear Management Company, LLC (NMC), the former licensee, provided responses to GL 2004-02 for Palisades Nuclear Plant (PNP). In these letters, NMC described plans for plant modifications that included the installation of new sump passive strainers, installation of new containment spray isolation valves with throttling capability, and the implementation of an alternate buffer during the 2007 fall refueling outage. NMC also described results and further plans to evaluate downstream components using the methodology provided in WCAP-16406-P, "Evaluation of Downstream Sump Debris Effects in Support of [Generic Safety Issue] GSI-191." Further, plans were described to evaluate the Pressurized Water Reactor (PWR) Owners Group acceptance parameters and the PNP-specific fuel assembly characteristics, if necessary, for determining the downstream chemical and debris effects on fuel clogging. Additionally, NMC described plans for evaluating the adequacy of the strainer design, and to address chemical effects through use of WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191," and plant-specific strainer testing.

Information Notice (IN) 2005-26, "Results of Chemical Effects Head Loss Tests in a Simulated PWR Sump Pool Environment," (Reference 5) was issued to inform licensees that recent research results indicate that a simulated sump pool environment containing phosphate and dissolved calcium can rapidly produce a calcium phosphate precipitate that, if transported to a fiber bed covered screen, produces significant head loss. This information is relevant to plants containing phosphate (e.g., plants using trisodium phosphate (TSP) as a sump pool buffering agent) and calcium sources (e.g., insulation, concrete) that may dissolve within the post loss-of-coolant accident (LOCA) containment pool with sufficient concentrations to form calcium phosphate precipitate. These test results indicate that substantial head loss can occur if sufficient calcium phosphate is produced in a sump pool and transported to a preexisting fiber bed on the sump screen. IN 2005-26 was applicable to PNP because TSP was used as the buffering agent, and there were calcium sources within containment, including containment concrete and two forms of calcium silicate: 1) pipe insulation and 2) Marinite® fiber board. NMC responded to IN 2005-26 on November 30, 2005 (Reference 6). NMC concluded that compensatory actions already implemented as a

result of NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," (Reference 7) were still appropriate, and two additional compensatory measures were being evaluated. These were: 1) isolating or removing TSP for one cycle, and 2) permanently sequestering calcium silicate. Since that time, Entergy Nuclear Operations, Inc., (ENO) replaced TSP with an alternate buffer, sodium tetraborate, during the 2007 refueling outage, which eliminated the calcium phosphate precipitate concern.

Additionally, during the PNP 2007 refueling outage: 1) the original containment sump screens were replaced by containment sump passive strainer assemblies, 2) the CSS valves were replaced with a new design that automatically repositions the valves to throttle positions at initiation of containment sump recirculation, and 3) the mechanical seals and seal coolers for the high pressure safety injection (HPSI) pumps were replaced. These modifications represent a significant improvement over the previously existing design by providing greatly increased strainer surface areas, increased net positive suction head (NPSH) margin, and reduced downstream effects. These modifications are more fully described in Section 3.2, Mitigative Measures. The evaluations of the adequacy of the strainer design to handle the predicted post-LOCA debris and chemical loads have continued in accordance with Reference 8 with justifiable refinements.

On December 3, 2007, ENO requested an extension for completion of GL 2004-02 corrective actions until June 30, 2008 (Reference 14). The NRC approved the extension request in a letter dated December 21, 2007 (Reference 15). ENO proceeded on debris transport computational fluid dynamics (CFD) calculations and, in-vessel and ex-vessel downstream effects analysis. Chemical effects strainer testing was conducted in May 2008 at Alden Research Laboratory (ARL). The chemical effects strainer testing was performed in accordance with the methodology contained in WCAP-16530-NP, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191."

2.0 Reason for the Request for Extension

ENO identified technical issues during head loss and chemical effects testing that require additional testing and evaluation. Additional time is needed to complete testing and analysis and, if needed, plan and complete modifications for PNP. Additional strainer debris and chemical effects testing is needed. The recently completed tests appear to be very conservative. ENO is considering changes to the test plan. Also, ENO plans to evaluate changes to testing inputs through reanalysis and design changes. Overall, ENO is pursuing testing to achieve acceptable results and supporting analysis and potential modifications. Efforts would be performed in parallel, as necessary, to support implementation of any required modifications during the 2009 refueling outage. Due to scheduling constraints with other domestic and foreign users of the ARL facility, ENO is currently planning on retesting in September 2008.

ENO's strategy for resolution of GL 2004-02 includes completing an analysis of the downstream effects on the fuel per WCAP-16793-NP, "Evaluation of Long-Term Cooling Associated with Sump Debris Effects," that is currently under NRC review. ENO revised its analysis of downstream components to include the recently revised WCAP-16406-P for pump wear. Efforts on both the in-vessel and ex-vessel downstream effects evaluations are nearly complete. The schedules for the owner reviews of these vendor supplied products were impacted as additional attention was given to strainer testing activities. The results from both evaluations are favorable and require no physical changes to the plant. Final processing of these evaluations within ENO's design documentation system is expected to be completed in the third quarter of 2008. Currently, any changes to strainer testing inputs that are required to support acceptable testing results is anticipated to conservatively impact both of the downstream evaluations. ENO plans to re-evaluate the WCAP-16793-NP evaluation for impact following release of the NRC safety evaluation (SE). As the timing of the SE is unknown, this would be handled independently from this extension request.

Considering the above, ENO requests an extension to complete corrective actions required by GL 2004-02 for PNP from June 30, 2008, to December 31, 2008, provided no hardware modification is required. This would allow ENO time to complete the strainer head loss and chemical effects testing, receive the vendors' test reports for head loss and chemical effects testing, complete the downstream effects evaluations and determine if plant hardware or procedure modifications are required. Should hardware modification be necessary, ENO proposes to implement the modification prior to restart from the 2009 refueling outage.

3.0 Technical Basis for Proposed Extension

ENO considers that the conditions at PNP continue to meet the criteria identified in SECY-06-0078, "Status of Resolution of GSI-191, Assessment of Debris Accumulation on PWR Sump Performance," (Reference 9), for extension beyond the completion date of December 31, 2007, specified in GL 2004-02. The SECY criteria are:

Proposed extensions to permit changes at the next outage of opportunity after December 2007 may be acceptable if, based on the licensee's request, the staff determines that:

- The licensee has a plant-specific technical/experimental plan with milestones and schedule to address outstanding technical issues with enough margin to account for uncertainties.
- The licensee identifies mitigative measures to be put in place prior to December 31, 2007, and adequately describes how these mitigative measures will minimize the risk of degraded ECCS and CSS functions during the extension period.

For proposed extensions beyond several months, a licensee's request will more likely be accepted if the proposed mitigative measures include temporary physical improvements to the ECCS sump or materials inside containment to better ensure a high level of ECCS sump performance.

These criteria are met as described below.

3.1 Plant Specific Technical/Experimental Plan

In References 2, 3, and 4, NMC submitted descriptions of the actions to be taken to address GL 2004-02. The key actions and current status are summarized below.

- (1) Completed Actions
 - (a) Debris generation, debris transport, and downstream effects calculations and evaluations.
 - (b) Strainer debris head loss testing.
 - (c) Strainer bypass testing.
 - (d) Installation of sump passive strainers.
 - (e) Replacement of CSS isolation valves.
 - (f) Replacement of high pressure safety injection pumps seals and seal coolers.
 - (g) Replacement of trisodium phosphate buffer with sodium tetraborate.
 - (h) Generic chemical effects strainer test protocol developed by strainer vendor (Performance Contracting, Inc).
- (2) Actions in Progress
 - (a) CFD and test inputs for subsequent chemical effects strainer testing.
 - (b) Reevaluate downstream effects to incorporate WCAP-16406-P, Revision 1, scheduled for completion in third quarter of 2008.
 - (c) Complete an analysis of the downstream effects on the fuel per WCAP-16793-NP, scheduled for completion in third quarter of 2008. ENO plans to assess the PNP specific evaluation for impact when the NRC SE is issued on WCAP-16793-NP.

- (3) Planned Actions
 - (a) Complete chemical effects strainer testing by September 30, 2008.
 - (b) Complete strainer debris and chemical effects test report including supporting analyses for testing and inputs by December 31, 2008.
 - (c) Complete any necessary modifications prior to restart from the 2009 refueling outage.
 - (d) Complete design and license bases updates, and provide final update to GL 2004-02 supplemental response by February 27, 2009, if no modification is required, or 60 days following completion of the 2009 refueling outage if modification is required.

3.2 Mitigative Measures

ENO has put in place the following mitigative measures that minimize the risk of degraded ECCS and CSS functions during the extension period:

- (1) Installation of replacement sump strainers

During the 2007 refueling outage, the original containment sump screens (approximately 52 ft²) were replaced. The replacement strainers are a modular design and have a surface area of approximately 3500 ft². The previous sump screens consisted of 0.047" diameter wire on 0.125" square center spacing. The new strainers consist of 0.045" diameter hole perforated plate. These strainers were designed to minimize fiber debris bypass to reduce downstream effects, and to provide a substantial increase in available strainer surface area. The new strainers provide increased margin against blockage and excessive wear of downstream components due to debris in the water.

- (2) Installation of replacement containment spray valves

During the 2007 refueling outage, the containment spray valves were replaced with a new design that automatically repositions to a throttle position, at initiation of containment sump recirculation. This new design gains NPSH margin, which provided allowance for the additional head loss due to the new passive strainers.

(3) Implementation of a new buffer

During the 2007 refueling outage, the previous containment trisodium phosphate buffer was replaced with sodium tetraborate. This eliminated the potential calcium phosphate chemical effects concern.

(4) Replacement of high pressure safety injection pump seals and seal coolers

During the 2007 refueling outage, the mechanical seal system for the HPSI pumps was replaced with a mechanical seal system that is not susceptible to post-LOCA debris-induced failure. This ensures that the HPSI pumps are capable of performing their safety-related design function during their required mission time of 30 days under post-LOCA conditions.

(5) Implementation of mitigative measures in response to NRC Bulletin 2003-01

In addition to the plant modifications described above, current mitigative measures in response to NRC Bulletin 2003-01 are in place and continue to be in effect. The responses to Bulletin 2003-01 are documented in References 10, 11 and 12, and include implementation of compensatory measures including candidate operator actions, as described in WCAP-16204, "Evaluation of Potential ERG [Emergency Response Guideline] and EPG [Emergency Procedure Guideline] Changes to Address NRC Bulletin 2003-01 Recommendations." By letter dated August 14, 2003 (Reference 13), the NRC provided notification that the 60-day response actions for compensatory measures that have been, or will be, implemented to reduce the interim risk associated with potentially degraded or nonconforming ECCS and CSS recirculation functions, are considered complete for PNP.

These measures include:

- (a) Training the licensed operators on sump clogging.
- (b) Revising plant off normal procedure (ONP) to lower entry conditions from Technical Specification value of one gallon per minute (gpm) unidentified leakage to 0.15 gpm unidentified leakage. The reactor trip value in the ONP was lowered from 20 gpm to 10 gpm unidentified leakage.
- (c) A procedure to provide specific direction for injecting water into the primary coolant system from an alternate water source.
- (d) Enhancements to improve containment drainage paths.

- (e) Steps to refill the safety injection and refueling water tank following recirculation.
 - (f) More aggressive cooldown and depressurization following a small break LOCA.
 - (g) Guidance on symptoms and identification of containment sump blockage.
 - (h) Contingency actions in response to containment sump blockage, loss of suction, and cavitation.
 - (i) Securing one containment spray pump before recirculation alignment.
- (6) In addition to the above:
- (a) Programmatic controls ensure that materials that are introduced to containment are identified and evaluated to determine if they could affect sump performance or lead to downstream equipment degradation.
 - (b) Programmatic controls ensure that configuration control of insulation and coatings inside containment are maintained.
 - (c) Containment cleanliness is assured by procedural controls that apply to containment entries, and prior to exiting Mode 5 during plant startup.

3.3 Generic Letter 2004-02 Basis for Continued Operation

The NRC staff provided a justification for continued operation (JCO) (as discussed in Reference 1), for pressurized water reactors through December 31, 2007. The following elements of the JCO would remain applicable to PNP during the proposed extension period. These provide additional assurance that the ECCS can perform its safety function in the event of a LOCA.

- (1) Switchover to recirculation from the sump during a large break LOCA would not occur until 20 to 30 minutes after accident initiation, allowing time for much of the debris to settle in other places within containment.
- (2) The probability of the initiating event is extremely low.
- (3) The NPSH analysis for the ECCS and CSS pumps do not credit containment overpressure.

Based on the applicability of these elements of the JCO, the completed modifications and other mitigative measures in place to reduce risk, the actions in progress, and planned actions for evaluation and testing, ENO concludes that an extension of the completion date for GL 2004-02 is justified.

3.4 Risk Evaluation

This evaluation examines the risk of a large break LOCA assuming that the sump screens are unable to meet the design basis chemical debris load given that the present testing is not finished.

As mentioned above, the probability of a large break LOCA is very low. Moreover, the class of LOCAs most likely to transport debris to the ECCS sump is large break LOCAs due to the sizeable zone of influence (ZOI) they create, the higher flow rates required for mitigation and the likelihood of containment spray actuation. These LOCAs have a very low probability of occurrence, as described in the following.

The core damage frequency (CDF) is calculated by multiplying the LOCA frequency (7.8E-06/yr) by the conditional probability of the break creating enough debris to result in unacceptable sump performance, which will conservatively be assumed to equal one. Given that the large break LOCA baseline core damage frequency is 1.92E-08/yr the annual increase in CDF is estimated to be about 7.78E-06/yr.

$$\Delta\text{CDF} \approx 7.8\text{E-}06/\text{yr} - 1.92\text{E-}08/\text{yr} \approx 7.78\text{E-}06/\text{yr}$$

This ΔCDF is considered small and falls into the Region II of the acceptance guidelines for CDF in Regulatory Guide (RG) 1.174, "An Approach for using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" (reference 16). These guidelines state that when the increase in CDF is between 1E-06 and 1E-05 per year, an application will be considered only if it can be reasonably shown that the total CDF is less than 1E-04 per year. Given that the baseline PNP CDF is 2.49E-05/yr and adding the above calculated ΔCDF of 7.78E-06/yr results in a new total value of 3.27E-05/yr, which is less than 1E-04 per year.

Given that the preliminary ARL results demonstrated that the Performance Contracting, Inc. (PCI) Sure-Flow™ Suction Strainer prototype module was able to handle amounts of non-chemical debris types listed below that would be more representative for a large break, it is considered that the sump screens would remain operable for smaller break sizes.

- Low density fiberglass / NUKON & thermal wrap
- Latent fibers and particulate
- Calcium silicate
- Qualified coatings within the ZOI

- Unqualified coatings

Large Early Release Frequency (LERF) was evaluated for large break LOCAs. Again assuming that the large break created enough debris to result in unacceptable sump performance, the Δ LERF was estimated by subtracting the LERF baseline value of $2.69\text{E-}07$ /yr from the LERF associated with conditional failure of the sump screens. As a result the annual increase in LERF is estimated to be about $9.41\text{E-}08$ /yr.

$$\Delta\text{LERF} \approx 3.63\text{E-}07/\text{yr} - 2.69\text{E-}07/\text{yr} \approx 9.41\text{E-}08/\text{yr}$$

With the Δ LERF less than $1\text{E-}07$ per year, this is categorized as very small and falls into Region III of the LERF acceptance guidelines as described in RG 1.174. That is, when the calculated increase in LERF is very small, which is taken as being less than $1\text{E-}7$ per reactor year, the change will be considered regardless of whether there is a calculation of the total LERF (Region III).

External events have negligible impact on the sump evaluation. Piping inside containment is well protected from most external events with the exception of seismic and fire events. The frequency of seismic events that could induce a primary coolant system pipe break is negligible. Moreover, no fire induced large break LOCAs have been identified and are also considered noncredible.

4.0 References

1. NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004 (ML042360586)
2. NMC letter, "Nuclear Management Company Response to Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors,' for Palisades Nuclear Plant," dated August 25, 2005 (ML052500280)
3. NMC letter, "Generic Safety Issue 191 Project Update for Palisades Nuclear Plant," dated May 12, 2006 (ML061320249)
4. NMC letter, "Nuclear Management Company Updated Response to Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors,' for Palisades Nuclear Plant," dated July 18, 2006 (ML061990310)
5. Information Notice 2005-26, "Results of Chemical Effects Head Loss Tests in a Simulated PWR Sump Pool Environment," dated September 16, 2005 (ML052570220), and Information Notice 2005-26, Supplement 1, dated January 20, 2006 (ML060170102)

6. NMC letter, "Response to Information Notice 2005-26, 'Results of Chemical Effects Head Loss Tests in a Simulated PWR Sump Pool Environment,' for Palisades Nuclear Plant," dated November 30, 2005 (ML053340462)
7. NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," June 9, 2003 (ML031600259)
8. Nuclear Energy Institute (NEI) 04-07, Volume 1, "Pressurized Water Reactor Sump Performance Methodology," (ML041550332), and NEI 04-07, Volume 2, "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02, Revision 0, December 6, 2004" (ML043280007)
9. SECY-06-0078, from L. A. Reyes, NRC Executive Director for Operations, to NRC Commissioners, "Status of Resolution of GSI-191, Assessment of [Effect of] Debris Accumulation on PWR [Pressurized Water Reactor] Sump Performance," dated March 31, 2006 (ML053620174)
10. NMC letter, "Nuclear Regulatory Commission Bulletin 2003-01: Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors - 60 Day Response," dated August 5, 2003 (ML032250084)
11. NMC letter, "Supplement to 60-Day Response to Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated May 17, 2004 (ML041410026)
12. NMC letter, "Revision of Commitment from Supplement to Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated December 15, 2005 (ML053490051)
13. NRC letter, "Palisades Plant – Response to NRC Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated August 14, 2003 (ML032230019)
14. ENO letter, "Request for Extension of Completion Date for Corrective Actions Required by Generic Letter 2004-02," dated December 3, 2007 (ML073371169)
15. NRC letter, "Generic Letter 2004-02 "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized Water Reactors" Extension Request Approval for Palisades Nuclear Plant (TAC NO. MC4701)," dated December 21, 2007 (ML073530640)
16. USNRC Regulatory Guide 1.174, "An Approach for using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 1, dated November 2002