UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

December 9, 2009

EA-09-269

Mr. Christopher J. Schwarz
Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT NRC INSPECTION REPORT 05000255/2009008; PRELIMINARY WHITE FINDING

Dear Mr. Schwarz:

On November 9, 2009, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Palisades Nuclear Plant. The enclosed report documents the inspection findings, which were discussed on November 9, 2009, with you and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel.

This report documents one NRC-identified finding that appears to have low to moderate safety significance (White). This finding was determined to involve a violation of NRC requirements. As documented in Section 4OA2 of this report, the Spent Fuel Pool (SFP) neutron absorber degraded to the extent that the SFP no longer met the requirements of the Design Feature for fuel storage in Technical Specification 4.3.

This finding was assessed based on the best available information, using the Significance Determination Process (SDP). Preliminarily, we consider this a NRC-identified finding having low to moderate safety significance based on a qualitative review using Inspection Manual Chapter (IMC) 0609 Appendix M. The degradation of the fixed neutron absorber resulted in a significant loss of one of the two barriers preventing criticality in the SFP. Although the condition did not lead to a criticality, the condition did present an immediate safety concern, and your staff implemented compensatory measures to ensure that the SFP remained subcritical. The NRC acknowledged the compensatory measures in Confirmatory Action Letter (CAL) RIII-08-003 in September of 2008. In February 2009, the NRC approved, and you implemented,

a licensee amendment that resulted in restoration of the SFP to compliance with the Design Feature in Technical Specification 4.3. The NRC closed the CAL on February 20, 2009. This finding is also an apparent violation of NRC requirements and is being considered for escalated enforcement action in accordance with the NRC Enforcement Policy. The current Enforcement Policy can be found on the NRC's Web site at http://www.nrc.gov/reading-rm/doc-collections/enforcement.

In accordance with IMC 0609, we intend to complete our evaluation using the best available information and issue our final determination of safety significance within 90 days of this letter. The SDP encourages an open dialogue between the staff and the licensee; however, the dialogue should not impact the timeliness of the staff's final determination. Before the NRC makes its enforcement decision, we are providing you an opportunity to either: (1) present to the NRC your perspectives on the facts and assumptions used by the NRC to arrive at the finding and its significance at a Regulatory Conference, or (2) submit your position on the finding to the NRC in writing. If you request a Regulatory Conference, it should be held within 30 days of the receipt of this letter and we encourage you to submit supporting documentation at least 1 week prior to the conference in an effort to make the conference more efficient and effective. If a conference is held, it will be open for public observation. The NRC will also issue a press release to announce the conference. If you decide to submit only a written response, such a submittal should be sent to the NRC within 30 days of the receipt of this letter. If you decline to request a Regulatory Conference or to submit a written response, you relinquish your right to appeal the final SDP determination; in that, by not doing either you fail to meet the appeal requirements stated in the Prerequisite and Limitation Sections of Attachment 2 of IMC 0609.

Please contact John Giessner at (630) 829-9619 within 10 days of the date of this letter to notify the NRC of your intended response. If we have not heard from you within 10 days, we will continue with our significance determination and enforcement decision. You will be advised by a separate correspondence of the results of our deliberations on this matter.

Since the NRC has not made a final determination in this matter, no Notice of Violation is being issued for this inspection finding at this time. Please be advised that the number and characterization of the apparent violation described in the enclosed inspection report may change as a result of further NRC review.

If you decide to provide a written response in lieu of the Regulatory Conference, the submission should be sent to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with copies to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the Resident Inspector Office at the Palisades Nuclear Power Plant.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Steven West, Director
Division of Reactor Projects

Docket Nos. 50-255; 72-007
License Nos. DPR-20

Enclosure: Inspection Report 05000255/2009008;
w/Attachment: Supplemental Information

cc w/encl: Distribution via ListServ

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos:	50-255
License Nos:	DPR-20
Report No:	05000255/2009008
Licensee:	Entergy Nuclear Operations, Inc.
Facility:	Palisades Nuclear Plant
Location:	Covert, MI
Dates:	October 1, 2009, through November 9, 2009
Inspectors:	J. Ellegood, Senior Resident Inspector T. Taylor, Resident Inspector L. Kozak, Senior Reactor Analyst
Approved by:	J. Giessner, Chief Branch 4 Division of Reactor Projects

Enclosure

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SUMMARY OF FINDINGS

IR 05000255/2009008; 10/01/2009 – 11/09/2009; Palisades Nuclear Plant; Problem Identification and Resolution

This report covers an inspection by the resident inspectors of degradation of the fixed neutron absorber in the Spent Fuel Pool (SFP). The inspectors identified one apparent violation (AV) with a preliminary significance of White. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP). Cross-cutting aspects were determined using IMC 0305, "Operating Reactor Assessment Program." Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

A. NRC-Identified and Self-Revealed Findings

Cornerstone: Initiating Events

Preliminary White. The inspectors identified a finding and associated violation of the Design Feature for fuel storage in Technical Specification 4.3.1 due to loss of neutron absorption capability in the spent fuel pool (SFP) racks. Over the life of the facility, the neutron absorber in the SFP had degraded such that the Region I of the SFP could no longer maintain an effective neutron multiplication factor (K_{eff}) of less than .95 without credit for soluble boron. Specifically, the licensee did not evaluate the effects of spent fuel pool rack swelling or available operating experience to validate the neutron absorber in the SFP continued to meet the assumptions in the criticality analysis. After testing revealed that the SFP no longer met assumptions in the criticality analysis, the licensee implemented compensatory actions to ensure the SFP remained subcritical.

The inspectors concluded the finding was more than minor because, if left uncorrected, it would become a more significant safety concern; in addition, the finding impacted the initiating event cornerstone objective of limiting events that challenge safety functions; for example, preventing criticality in an area not designed for criticality. Because probabilistic risk assessment tools were not suited for this finding, the inspectors evaluated the finding using IMC 0609, Appendix M, "Significance Determination Process Using Qualitative Criteria." Based on the degradation that resulted in a significant loss of margin to criticality, NRC management concluded the finding was preliminarily of low to moderate safety significance (White). The inspectors determined that the performance deficiency did not reflect current licensee performance due to its age; therefore, the finding does not include a cross-cutting aspect. (4OA2)

B. Licensee-Identified Violations

No violations of significance were identified.

REPORT DETAILS

4. OTHER ACTIVITIES

4OA2 Identification and Resolution of Problems

.1 Selected Issues for Follow-Up: Degradation of Fixed Neutron Absorber in the Spent Fuel Pool (SFP)

a. Inspection Scope

The inspectors reviewed data related to the degradation of the SFP fixed neutron absorber. Since the issue has been the subject of prior NRC inspection activities, this inspection focused on reviewing the analysis by the licensee to determine SFP K_{eff} and determine any performance deficiencies related to the degradation of the SFP. Based on the inspection, the inspectors concluded that the licensee had opportunities to identify the degradation through both evaluations of Operating Experience and analysis of swelling of the rack in the SFP.

b. Findings

Introduction: The inspectors identified a finding and associated violation of the Design Feature for fuel storage in Technical Specification 4.3.1 due to loss of neutron absorption capability in the SFP racks. Over the life of the facility, the neutron absorber in the SFP had degraded such that Region I of the SFP could no longer maintain a K_{eff} of less than .95 without credit for soluble boron.

Description: In September, 2007, while making fuel moves in the SFP in preparation for a refueling outage, the licensee initiated a condition report documenting that a bundle in the spent fuel pool could not be removed from its current storage location. This was the second bundle the licensee had identified as stuck during the preparations for the outage. The Palisades resident inspectors read the condition report during a routine review of condition reports and questioned the licensee on conditions in the SFP. The licensee informed the inspectors that the fuel became stuck due to swelling of the fuel rack. The licensee also informed the inspectors that there were multiple bundles stuck in their current storage location and the licensee did not consider the condition to adversely affect safety. The licensee assigned the condition report a significance level of “C,” which would not receive a cause determination. In October of 2007, after the inspectors engaged licensee management regarding the potential safety implications, the licensee upgraded the condition report to a “B” level. The licensee decided that the condition would be the subject of a lower tier apparent cause evaluation - the lowest level of cause evaluation in the licensee’s corrective action process. The inspectors performed a Problem Identification and Resolution inspection sample on the condition in the fourth quarter of 2007, but insufficient data existed to determine if there was any performance deficiency associated with the SFP racks.

Palisades has one spent fuel pool with two different rack designs forming two regions with different criticality controls for each region. Each region has different rack designs and requirements for soluble boron. Region I racks were manufactured by the Nuclear

Utility Services (NUS) Corporation and include boron carbide (B_4C) plates manufactured by the Carborundum Corporation. The B_4C acts as a neutron absorber and the licensee assumed no change in the neutron absorption characteristics over the life of the SFP. For this region, the Palisades design feature Technical Specifications (TS) required K_{eff} to be less than 0.95 if fully flooded with unborated water. At the time of discovery, there were no limiting conditions for operations associated with Region I. In Region II, the design feature TS credit 850 ppm soluble boron to maintain K_{eff} less than 0.95. In addition, K_{eff} must remain below 1.00 if Region II is flooded with unborated water. Limiting Conditions for Operations for Region II address boron concentration and the types of spent fuel that can be stored in the region. The controls for both of the regions meet the requirements of 10 CFR 50.68, Criticality Accident Requirements. Although the Region II racks contain Boraflex as a neutron absorber, the criticality analysis does not credit the Boraflex.

In 1988, the licensee first identified that some rack locations were swelling when they were unable to load a fuel bundle into a storage location. The licensee first identified a stuck bundle in 1991 and there are now 11 fuel bundles that are stuck in their current location and 3 more locations that have swollen walls. However, in 1994, the licensee and NUS evaluated the condition and concluded gas generated from irradiation caused the swelling. This conclusion has not been confirmed; therefore, there may be another cause of the rack swelling. The licensee could not show that the effects of the swelling on neutron absorber degradation had ever been evaluated nor that the effects of gas pockets on the criticality analysis had been considered. Until July of 2008, the licensee had not performed testing on the SFP neutron absorption capability. In response to the inspector's concerns, the licensee accelerated testing committed for license extension to determine the neutron absorption capability of the SFP racks. In July of 2008, the testing revealed that the neutron absorber in the SFP racks had deteriorated and the SFP no longer met the TS requirements for K_{eff} in Region I of the SFP. The licensee performed a criticality assessment of the pool and concluded that with 50 percent depletion of the neutron absorber, the pool remained with a K_{eff} of less than 1.00 and with a K_{eff} of less than 0.95 with 150 ppm boron. The licensee committed to additional controls to ensure the SFP remained sub-critical. On September 19, 2008, the NRC issued confirmatory action letter (CAL) RIII-08-003 to Palisades to confirm these commitments. On February 6, 2009, the NRC approved a license amendment for the SFP and the licensee established compliance with the TS. The CAL was closed on February 20, 2009.

On September 15, 2008, the licensee issued Licensee Event Report (LER) 08-004 which informed the NRC that the licensee did not comply with their TS requirements for Region I of the SFP. The inspectors reviewed the LER in inspection report 2008-004, but did not close the LER because the licensee did not have enough information for the NRC to determine the cause and safety significance of the condition. The NRC discussed the need for additional information with the licensee and the licensee informed the inspectors of their plans for additional testing of the SFP, as well as plans to evaluate the criticality conditions in the pool prior to adoption of additional controls.

As part of licensee actions to better understand the degradation of the neutron absorber in the SFP, the licensee conducted additional testing of the SFP neutron absorber in December 2008. This testing confirmed the degradation and provided enough information for the licensee to quantify the degradation for the sample of neutron absorber panels that were tested. Approximately 2 percent of all the panels were tested. Testing could not be completed on panels where irradiated fuel was stuck. The testing

showed significant degradation of up to 70 percent loss of boron (by mass) of the absorber in some of the panels.

In the spring of 2009, the licensee performed a criticality assessment of the historical pool conditions that incorporated the results from the testing and provided the evaluation to the inspectors in June of 2009. The calculation performed by the licensee evaluated the infinite neutron multiplication factor (K_{inf}). K_{inf} assumes an infinite array of fissile material and yields a conservative value. Since the licensee did not test all the panels, the assessment used statistical methods to determine the worst case boron depletion. The licensee concluded that the SFP did not meet the requirements of the design features, but the pool would remain slightly subcritical for the most reactive fuel stored in the SFP without credit for soluble boron. Criticality experts from the office of Nuclear Reactor Regulation performed an independent evaluation of the licensee conclusions on the extent of the Carborundum neutron absorber degradation and identified the following concerns with the licensee's analysis:

1) The licensee assumed a Carborundum boron 10 isotope (B-10) areal density reduction of 85 percent, a value 0.0135 gm/cm^2. This was approximately 50 percent below the areal density measured during the licensee's limited testing.

   a) Although testing of a limited number of panels did not identify any Carborundum with a B-10 areal density less than 0.0135 gm/cm^2, the NRC could not conclude that other panels in the pool did not have a lower areal density, especially since no testing could be completed where irradiated fuel was stuck. Since the degradation mechanism is not known, the NRC did not believe that the licensee could bound areal B-10 density at 0.0135 gm/cm^2.

   b) The NRC did not agree that representing the decrease in B-10 areal density from the original 0.09166 gm/cm^2 as material thinning was supported.

   c) The licensee replaced the "lost" Carborundum with SFP water. The potential for the "lost" Carborundum to be filled with inert material was not addressed.

2) Localized boron dilution events were not considered or discussed.

3) The effect of the swelling on the criticality analysis was not addressed. The submittal in November 2008 indicated the maximum swelling was worth approximately 0.05 delta (Δ) K_{eff}. If even 10 percent of this maximum is present, the licensee's conclusion was potentially invalid.

4) The licensee mixed analysis codes CASMO 3 and MONK results. The licensee determined the reactivity worth of the degraded Carborundum with CASMO 3 and added that value to a total reactivity calculated from MONK. The NRC could not conclude that CASMO 3 and MONK would come up with the same ΔK_{inf}, which might invalidate the licensee's conclusion.

5) The licensee made an implicit assumption that all of the biases, uncertainties, and limiting conditions have not changed even though there was a significant reduction in the B-10 areal density and swelling in the cell walls.

In the licensee's evaluation, with no credit for soluble Boron and 85 percent degradation of the Carborundum, the calculated K_{inf} was 0.995016. Because of these questions regarding the licensee's criticality analysis, the NRC concluded that the analysis did not provide a reasonable bound on K_{eff} for the SFP and, therefore, did not demonstrate that K_{eff} would be less than 1.0 without credit for soluble Boron.

Analysis: In accordance with NRC IMC 0612, Appendix B, "Issue Screening," the inspectors determined that the licensee's failure to maintain K_{eff} less than 0.95 in Region I without credit for soluble Boron was a performance deficiency warranting a significance determination. The inspectors determined the finding was within the licensee's ability to foresee and correct since the licensee had access to operating experience indicating degradation of Carborundum racks at other facilities. In addition, the licensee took ineffective action for fuel binding in the spent fuel pool. The inspectors determined that the finding did not have an actual safety consequence, did not impact the NRC's ability to perform a regulatory function and did not include any willful aspects. Therefore, the inspectors concluded that the finding did not require use of traditional enforcement. The inspectors concluded the finding was more than minor for the following reasons:

1) If left uncorrected, the racks would continue to degrade. The degradation would further reduce the neutron absorption capability and become a more significant safety concern.

2) The finding is associated with the increase in the likelihood of an initiating event; that is, a criticality

SDP Phase 1 does not address SFP criticality issues. Although the barrier cornerstone has questions related to SFP cooling and handling, it does not address criticality. Since probabilistic risk assessment tools and existing SDP guidance did not address SFP criticality issues, the inspectors reviewed the issue using Appendix M of IMC 0609. The completed Appendix M is attached.

While evaluating the significance of the condition, the inspectors concluded an inadvertent criticality would result in a Red or Severity Level I finding. The inspectors based this conclusion on multiple supplements in the Enforcement Policy identifying an inadvertent criticality as a Severity Level I finding and the inclusion of preventing a criticality as a strategic objective. The inspectors qualitatively considered the amount of remaining margin to an inadvertent criticality while preparing Appendix M. In this case, of the two required criticality controls (soluble boron and rack geometry/design), one criticality control (namely, the rack design with neutron absorber capability), was significantly degraded. It could not be determined if other, untested racks locations, could be more degraded.

Although one of the factors contributing to the finding was related to use of operating experience, the inspectors concluded that the opportunities were not recent enough to be reflective of current performance. Therefore, the finding does not include a cross-cutting aspect.

Old Design Issue Review

During review of the safety significance, the inspectors evaluated the finding for treatment as an old design issue. The performance deficiency did not meet the criteria

for an old design issue. NRC IMC 0305, "Operating Reactor Assessment Program," Section 04.11 defines an "old design issue" as an inspection finding involving a past design-related problem in the engineering calculations or analyses, the associated operating procedure, or installation of plant equipment that does not reflect a performance deficiency associated with existing licensee programs, policy, or procedures. As discussed in Section 12.01 of IMC 0305, some old design issues may not be considered in the assessment program. Section 12.01(a) provides guidance for the treatment of old design issues, and states that the NRC may refrain from considering safety significant inspection findings in the assessment program for a design-related finding in the engineering calculations or analysis, associated operating procedure, or installation of plant equipment if all of the following criteria are true:

1. It was licensee-identified as a result of a voluntary initiative such as a design basis reconstitution. For the purposes of IMC 0305, self-revealing issues are not considered to be licensee-identified. Self-revealing issues are those deficiencies which reveal themselves to either the NRC or licensee through a change in process, capability or functionality of equipment, or operations or programs.

   False. The issue was identified by the NRC resident inspectors during review of condition reports that documented a stuck fuel bundle during fuel movement in the SFP. The fuel movement occurred as part of outage preparations and not as part of an effort to identify issues with the SFP. Although the licensee was aware of fuel bundles sticking, they had not assessed the condition or determined if the Carborundum was losing absorption capability.

2. It was or will be corrected, including immediate corrective action and long term comprehensive corrective action to prevent recurrence, within a reasonable time following identification (this action should involve expanding the initiative, as necessary, to identify other failures caused by similar root causes). For the purpose of this criterion, identification is defined as the time from when the significance of the finding is first discussed between the NRC and the licensee. Accordingly, issues being cited by the NRC for inadequate or untimely corrective action are not eligible for treatment as an old design issue.

   True. The issue was corrected through submittal and implementation of a license amendment. It should be noted; however, this took considerable NRC involvement and issuance of a CAL. The license revision did not occur until 18 months after the inspectors initially raised concerns with the SFP racks.

3. It was not likely to be previously identified by recent ongoing licensee efforts such as normal surveillance, quality assurance activities, or evaluation of industry information.

   False. There were multiple opportunities for the licensee to identify the issue as more fuel bundles became stuck due to swelling of the racks.

4. The issue does not reflect a current performance deficiency associated with existing licensee programs, policy, or procedure.

   False. The issue reflected current performance as of the time the inspectors identified the issue because the inspectors became aware of the issue due to additional fuel bundles becoming stuck. The licensee did not adequately

evaluate the condition until the inspectors raised concerns with licensee management.

The inspectors concluded the issue met only one of the criteria for treatment as an old design issue.

Enforcement: Technical Specification 4.3.1, Amendment 189, required, in part that Region I fuel storage racks be designed and maintained with a $K_{eff} \leq 0.95$, if fully flooded with unborated water, which includes allowances for uncertainties as described in Section 9.11 of the Updated Final Safety Analysis Report (UFSAR).

Contrary to the above, from October 2007 until February 20, 2009, the licensee failed to maintain the Region I fuel storage racks with a $K_{eff} \leq 0.95$ when fully flooded with unborated water. Specifically, the Region I fuel storage racks contained fixed poison in the form of B_4C manufactured by the Carborundum Corporation that was significantly less than required by TS to ensure the design feature was met. The Carborundum neutron absorption capability degraded to the point that K_{eff} in Region I was greater than 0.95 under the bounding conditions described in Section 9.11 of the UFSAR if fully flooded with unborated water. Pending determination of final safety significance, this finding with the associated apparent violation will be tracked as AV 05000255/2009008-01, Loss of Spent Fuel Pool Neutron Absorption Capability. The licensee has moved fuel and obtained a license amendment to control fuel movement such that TS 4.3.1 is now satisfied.

4OA6 Management Meetings

.1 Exit Meeting Summary

On November 9, 2009, the inspectors presented the inspection results to C. Schwarz and other members of the licensee staff. The licensee acknowledged the issues presented. The inspectors confirmed that none of the potential report input discussed was considered proprietary.

Attachments: 1. Supplemental Information
2. Appendix M

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

C. Schwarz, Site Vice President
A. Blind, Engineering Director
T. Kirwin, Plant General Manager
M. Sicard, Operations Manager
R. Schmidt, Reactor Engineering Supervisor

NRC

M. Chawla, Palisades Project Manager
M. Yoder
K. Woods

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened

05000255/2009008-01	AV	Loss of Spent Fuel Pool Neutron Absorption Capability

Closed

NONE		

Discussed

05000255/2009008-004	LER	Noncompliance with TS 4.3.1.b

LIST OF DOCUMENTS REVIEWED

The following is a list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather, that selected sections of portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

4OA2 Problem Identification and Resolution

- CR-PLP-2008-03067, Badger Testing results Reveal Degradation, July 15, 2008
- CR-PLP-2008-03154, Non-conservative use of CASMO-4, July 21, 2008
- Evaluation of Palisades Degraded Region I Racks, August 8, 2008
- CR-PLP-2009-03067 CA-0034, Evaluation of Palisades Degraded Region I Racks, June 12, 2009
- Palisades Cycle 19 Startup and Operation Report
- CASMO Output Files for Palisades
- LER-05000255/2008-004, Non-compliance with TS 4.3.1.1.b, Rev 0

LIST OF ACRONYMS USED

Δ	delta
ADAMS	Agency-wide Document Access Management System
AV	apparent violation
B-10	boron 10 isotope
B_4C	boron carbide
CAL	Confirmatory Action Letter
CFR	Code of Federal Regulations
IMC	Inspection Manual Chapter
K_{eff}	effective neutron multiplication factor
K_{inf}	infinite neutron multiplication factor
LER	Licensee Event Report
NCV	Non-Cited Violation
NRC	U.S. Nuclear Regulatory Commission
NUS	Nuclear Utility Service
PARS	Publicly Available Records System
SDP	significance determination process
SFP	spent fuel pool
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report

(Attachment-- Appendix M)

TABLE 4.1

Qualitative Decision-Making Attributes for NRC Management Review

Decision Attribute	Applicable to Decision?	Basis for Input to Decision - Provide qualitative and/or quantitative information for management review and decision making.
Finding can be bounded using qualitative and/or quantitative information?	Yes	The worst case condition for the spent fuel pool (SFP) would be complete loss of the neutron absorption capability of the Carborundum with stored fuel enriched to 4.54 percent. In this case, with no soluble Boron, the SFP would be critical. The licensee has analyzed the test data and determined that the actual loss can be bounded by an 85 percent degradation with a K_{inf} of 0.995 without soluble boron. Since the degradation mechanism is not known, 85 percent degradation may not bound the condition.
Defense-in-Depth affected?	Yes	The affected region was designed and licensed to maintain K_{eff} less than 0.95. This limit allows for inaccuracies, variations, and human error while still preventing a criticality. In this case, the degradation severely eroded the margin to criticality. One of the two required barriers was significantly degraded. However, several factors mitigate the margin lost due to Carborundum degradation. These include: The other barrier, soluble boron in excess of the minimum concentration needed to maintain K_{eff}<.95; Mixing of irradiated fuel with new fuel; SFP temperature controls; and The SFP is finite
Performance Deficiency effect on the Safety Margin maintained?	Yes	The performance deficiency resulted in a significant impact on the safety margin. The degradation of the neutron absorber adversely affected K_{eff} in the pool, resulting in a K_{eff} exceeding 0.95 with no soluble boron. The final value exceeded both the TS limit and the 10 CFR 50.68(b)(4) limit.

The extent the performance deficiency affects other equipment.	Yes	The deficiency results in reduced neutron absorption capability in the SFP. Region I borders Region II and the reduction in results in some additional neutron leakage into Region II. The license amendment created additional spacing in the Region I row closest to Region II.
Degree of degradation of failed or unavailable component(s)	Yes	The licensee conducted two campaigns to evaluate degradation of the SFP using approved testing. The first campaign, in July 2008, identified the degradation but was not able to quantify the amount. A subsequent campaign in Dec. 2008, obtained quantifiable data. The lowest measured value for the set of plates measured was 0.0307 gm/cm^2 B-10. This represents a 70 percent reduction in Boron. The licensee bounded the degradation using statistical techniques to achieve a 95/95 confidence level. The bounding value is .0135 gm/cm^2 or ~85 percent degraded. Review of the analysis by criticality and material experts at NRR and the inspectors raised concerns that the analysis may not bound actual degradation. The licensee has only tested a subset of the total number of plates (~ 1.7 percent). The inspectors concluded that without additional knowledge of the degradation mechanism or broader testing of the SFP, that no credit can be assigned to Carborundum.

Period of time (exposure time) affect on the performance deficiency.	Yes	The licensee installed the racks in the late 1970's. The licensee did not have a coupon surveillance program or testing program to verify neutron absorption capability for the Carborundum; therefore, the licensee does not know when the degradation began. Test coupon data from other facilities that have Carborundum did not show degradation of the material; however, there is industry experience that shows some degradation of the material. Based on early experience in the industry, the licensee learned that the plates will generate gas that can cause rack swelling. The licensee drilled vent holes into the racks to alleviate the gas build up, but can not show if all components had been vented. In 1988, the licensee first identified that some rack locations had swelled. Based on this information, the inspectors concluded that the degradation may have occurred over a period of years, but can not determine when the plates began losing neutron absorption capability.
The likelihood that the licensee's recovery actions would successfully mitigate the performance deficiency.	No	The condition represents a potential initiating event. The event would be a SFP criticality. In such an event, significant consequences could occur before the criticality ceased. The licensee does not have procedures to address a SFP criticality. There is no analysis to evaluate the consequences of a criticality event in the SFP.

Additional qualitative circumstances associated with the finding that regional management should consider in the evaluation process.	Yes	The criticality evaluation performed by the licensee included several conservative assumptions including: an infinite array of fuel; all fuel was fresh fuel; no neutron leakage. However, given the size of the SFP, very little conservatism exists in the assumption that the SFP is an infinite array. The presence of soluble boron provides margin to criticality. The TS require a minimum value of 1720 ppm boron in the SFP. The minimum concentration for the last 16 years has been 2100 ppm. While the presence of soluble B-10 provides margin, a dilution event remains a credible, although unlikely, event. Although the licensee evaluated an inadvertent dilution, other initiating events which could cause SFP dilution have not been evaluated in any formal evaluation or program. As part of the review, experts from NRR reviewed the licensee's analysis. The reviewers identified weaknesses in the licensee's analysis that challenge the conclusion that K_{eff} would remain below 1 without credit for soluble B-10. The inspectors reviewed recent findings related to criticality controls and concluded a white finding is consistent with NRC precedent. Finally, the inspectors reviewed section VI of the enforcement policy to ensure an informed conclusion would be made in determining the significance of the finding. The inspectors concluded that this condition corresponded to a severity level III violation if traditional enforcement were used. The inspectors evaluation is summarized as follows:

Review of Enforcement Policy, Section VI: Enforcement Policy Supplement VI dated January 14, 2005, provides guidance on evaluating Violations related to criticality controls. The following examples are germane to the significance determination:	
Severity Level I:	A nuclear criticality accident; No Nuclear Criticality accident occurred; therefore the finding is not equivalent to severity level 1
Severity Level II:	A failure to establish, implement, or maintain all criticality controls (or control systems) for a single nuclear criticality scenario when a critical mass of fissile material was present or reasonably available, such that a nuclear criticality accident was possible; Although a critical mass of fissile material was present, some controls were still in place. Specifically, soluble boron was in the SFP and some B_4C remained. Therefore the finding is not equivalent to Severity Level II.

Severity Level III:	11. A system designed to prevent or mitigate a serious safety event being degraded to the extent that a detailed evaluation would be required to determine its operability; In this case, the Carborundum, which is part of the storage system designed to prevent the serious safety event of a criticality was substantially degraded. The licensee needed to perform a detailed evaluation, including testing of the SFP racks and additional criticality analysis to determine operability. These evaluations determined that the SFP no longer met its design function. In addition, the licensee's analysis still includes uncertainties such that the NRC can not conclude that the analysis bounds the SFP conditions. Therefore, the finding is equivalent to Severity level III. 12. Changes in parameters that cause unanticipated reductions in margins of safety; In this case, the Carborundum degraded and the degradation led to an unanticipated and significant reduction in margins of safety. Therefore, the finding is equivalent to Severity Level III. 16. A failure to establish, maintain, or implement all but one criticality control (or control systems) for a single nuclear criticality scenario when a critical mass of fissile material was present or reasonably available, such that a nuclear criticality was possible; In this case, a critical mass of fissile material was present. The licensee maintained control of the SFP boron concentration, although soluble boron was not credited in Region I. The inspectors consider a dilution event to be an unlikely, although credible, scenario. This conclusion is in concert with 10 CFR 50.68 which requires K_{eff} to be less than 1 when soluble boron is used for criticality control. Several scenarios were analyzed that may result in K_{eff} greater than 1. However, the results depend on assumed areal boron density. Based on review of the licensee's analysis and the presence of significant quantities of soluble boron, the inspectors concluded that equivalent of one criticality control remained. Therefore, the finding is equivalent to Severity Level III.

Result of Management review: White based on the significant loss of margin in one of the two required barriers to prevent criticality in the SFP.

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Sincerely,

/RA/

Steven West, Director
Division of Reactor Projects

Docket Nos. 50-255; 72-007
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****OE and NRR concurrence by emails on 11/30 – JEllegood by email (attached)***

Letter to C. Schwarz from S. West dated December 9, 2009

SUBJECT: PALISADES NUCLEAR PLANT NRC INSPECTION REPORT 05000255/2009008; PRELIMINARY WHITE FINDING

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