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10 CFR 50.90

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

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

License Amendment Request for Spent Fuel Pool Region I Criticality

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Nuclear Operations, Inc (ENO) requests Nuclear Regulatory Commission (NRC) review and approval of a proposed license amendment to amend Renewed Facility Operating License DPR-20 for the Palisades Nuclear Plant (PNP). ENO proposes to revise Appendix A, Technical Specifications (TS), as they apply to the spent fuel pool storage requirements in TS section 3.7.16 and the criticality requirements for the Region I spent fuel pool (SFP) and north tilt pit fuel storage racks, in TS section 4.3.1.1.

The criticality analysis supporting the proposed TS change for the Region I fuel storage racks reflects credit for empty storage cells. It also reflects credit for soluble boron in the same manner and magnitude that is credited for Region II fuel storage racks. The proposed change, in accordance with 10 CFR 50.68, Criticality accident requirements, would establish the effective neutron multiplication factor (Keff) limits for Region I storage racks based on analyses to maintain Keff less than 1.0 when flooded with unborated water, and less than, or equal to, 0.95 when flooded with water having a minimum boron concentration of 850 ppm during normal operations. The proposed change was evaluated for both normal operation and accident conditions. This proposed change provides an analysis that does not credit boron in the Carborundum® poison plates and incorporates a conservative swelling model of the plates in the Region I storage racks.

This proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c), and it has been determined that this change involves no significant hazards consideration. The bases for this determination are included in Enclosure 1. Enclosure 1 also provides a detailed description of the proposed change, a background discussion, a technical analysis, and an environmental review consideration. Enclosure 2 provides the revised TS pages reflecting the proposed changes. Enclosure 3 provides the annotated TS pages showing the proposed changes. Enclosure 4 contains AREVA NP Inc. report, Document No: ANP-2779NP-001, "Palisades SFP Region 1 Criticality Evaluation."

ENO submitted a letter dated August 27, 2008, describing four commitments to address the degraded SFP storage rack neutron absorber and plans to restore compliance. PNP Licensee Event Report 08-004, "Noncompliance with Technical Specification 4.3.1.1.b," dated September 15, 2008, described the noncompliance with TS 4.3.1.1b and 10 CFR 50.68. The NRC issued a Confirmatory Action Letter on September 18, 2008, confirming commitments by ENO in our August 27, 2008, letter, and acknowledging submittal of a license amendment to restore compliance.

To support fuel pool operations necessary to accommodate 2009 refueling activities, ENO requests approval of the proposed license amendment request by February 12, 2009, with the amendment being implemented within 60 days.

A copy of this request has been provided to the designated representative of the State of Michigan.

Summary of Commitments

This letter contains no new commitments and no revision to existing commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 25, 2008.

Christopher J. Schwarz
Site Vice President
Palisades Nuclear Plant

Enclosures (4)

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

ENCLOSURE 1
LICENSE AMENDMENT REQUEST FOR
SPENT FUEL POOL REGION I CRITICALITY
DESCRIPTION OF REQUESTED CHANGES

1.0 DESCRIPTION

Entergy Nuclear Operations, Inc. (ENO) requests to amend Renewed Facility Operating License DPR-20 for the Palisades Nuclear Plant (PNP) to revise Appendix A, Technical Specifications (TS), fuel storage requirements as they apply to the Region I storage racks in the PNP spent fuel pool and north tilt pit. The license amendment would revise the spent fuel assembly storage specification in TS 3.7.16 and the criticality section in TS 4.3.1.1 for the Region I fuel storage racks. The analysis to support the proposed changes takes credit for empty storage cells. In addition, credit is taken for soluble boron in the same manner and magnitude that it is credited for Region II. In accordance with 10 CFR 50.68, Criticality accident requirements, the effective neutron multiplication factor (Keff) limits for Region I storage racks are appropriately revised based on analyses to maintain Keff less than 1.0 when flooded with unborated water, and less than, or equal to, 0.95 when flooded with water having a minimum boron concentration of 850 ppm during normal operations. The proposed change is evaluated for both normal operation and accident conditions. This proposed change reflects an analysis that takes no credit for boron in the Carborundum® poison plates and incorporates a conservative swelling model of the plates in the Region I storage racks.

The arrangement of the Region I and Region II storage racks in the spent fuel pool is shown in Figure B 3.7.16-1 of the Technical Specifications Bases. The storage racks are located in the main pool area and the north tilt pit area of the spent fuel pool. The Region I storage racks contain Carborundum® plates as a neutron poison. There have been indications of plate swelling in the Region I racks. Indications of poison loss were discovered in recent attenuation measurements. The analysis to support this license amendment request (LAR) assumes a total poison loss in the Carborundum® plates and reflects a conservative swelling model.

2.0 PROPOSED CHANGE

ENO proposes to modify the spent fuel pool storage requirements in TS 3.7.16 and Region I fuel storage criticality requirements in the TS design features section 4.3.1.1 by adding a limiting condition for operation (LCO), action statement, and surveillance for Region I fuel and non-fissile bearing component storage and by describing requirements for new Regions 1A, 1B, and 1E in the proposed specifications that follow. The supporting analysis in Enclosure 4 has resulted in proposing restrictions on fuel assemblies and non-fissile bearing components in Region I of the spent fuel pool. This has resulted in proposed revisions to the TS that are unique and do no allow using exact wording from NUREG-1432, "Standard Technical Specifications, Combustion Engineering Plants." The content of the specifications follows NUREG-1432 to the extent possible. TS page numbers in TS section 4 would also change due to addition of text.

TS 3.7.16 title and page headers, would be revised, as would the title of TS 3.7.16 on the Table of Contents page ii change, as follows:

"Spent Fuel Pool Storage"

The change, from "Spent Fuel Assembly Storage," would be in accordance with NUREG-1432 and Technical Specifications Task Force traveler TSTF 255, Revision 1. The change is also consistent with the changes described below that add additional requirements for new fuel assemblies and non-fissile bearing component storage in the spent fuel pool in addition to spent fuel assemblies.

TS LCO 3.7.16 would be revised to add requirements for storage of fuel and non-fissile bearing components in Region I and read as follows:

"Storage in the Spent Fuel Pool shall be as follows:

a. Each fuel assembly and non-fissile bearing component stored in Region I shall be in accordance with Specification 4.3.1.1; and

b. The combination of initial enrichment, burnup, and decay time of each fuel assembly stored in Region II shall be within the requirements of Table 3.7.16-1."

The proposed change would add restrictions for Region I in LCO item "a" on fuel assembly and non-fissile bearing components and reference the restrictions that would be specified in the proposed changes to Specification 4.3.1.1. The current LCO that pertains to Region II is proposed as the new LCO item "b," with no change to the wording. The format differs from NUREG-1432 due to the unique aspects of the fuel and non-fissile bearing component storage restrictions for Region I and Region II of the spent fuel pool.

TS LCO 3.7.16 Applicability would be revised to read as follows:

"Whenever any fuel assembly or non-fissile bearing components are stored in the spent fuel pool or north tilt pit."

The proposed change to the Applicability is consistent with NUREG-1432 except that it adds the non-fissile bearing components. This deviation is appropriate due to the proposed restrictions on their storage in the Region I spent fuel storage racks in Specification 4.3.1.1.

TS 3.7.16 Required Action A.1 would be revised to read as follows:

"Initiate action to restore the noncomplying fuel assembly or non-fissile bearing component within requirements."

The proposed change alters the words provided in NUREG-1432 due to the addition of storage requirements for the non-fissile bearing components.

TS SR 3.7.16.1 Surveillance would be revised to read as follows:

"Verify by administrative means each fuel assembly or non-fissile bearing component meets the fuel storage requirements."

The proposed change alters the words provided in NUREG-1432 due to the addition of storage requirements for the non-fissile bearing components.

TS SR 3.7.16.1 Surveillance Frequency would be revised to read as follows:

"Prior to storing the fuel assembly or non-fissile bearing component in the spent fuel pool"

The proposed change alters the words provided in NUREG-1432 due to the addition of storage requirements for the non-fissile bearing components.

TS 4.3.1.1 would be revised and read as follows:

"The Region I fuel storage racks (See Figure B 3.7.16) incorporating Regions 1A, 1B, and 1E are designed and shall be maintained with:"

TS 4.3.1.1 contains requirements for Region I fuel storage racks. The proposed revision requires that Regions 1A, 1B, and 1E be designated within Region I. The requirements in regions 1A, 1B, and 1E are described below. The proposed changes within TS 4.3.1.1, including those below, result in revision of the specification that significantly differs from the wording in NUREG-1432.

TS 4.3.1.1a. would be revised and read as follows:

"Fuel assemblies having a maximum nominal planar average U-235 enrichment of 4.54 weight percent in Region 1A, 4.34 weight percent in Region 1B, and 3.05 weight percent in Region 1E with the exception of one assembly in Region 1E, described in 4.3.1.1i below, having a maximum nominal planar average U-235 enrichment of 3.26 weight percent;"

TS 4.3.1.1b. would change “Keff ≤ 0.95” to “Keff < 1.0” and read as follows:

“Keff < 1.0 if fully flooded with unborated water, which includes allowances for uncertainties as described in Section 9.11 of the FSAR;”

The analysis described in Enclosure 4 requires this proposed change. This change would be consistent with the requirement in TS 4.3.1.2b for Region II fuel storage racks.

TS 4.3.1.1c. would be renumbered as TS 4.3.1.1d and new TS 4.3.1.1c would be added as follows:

“Keff ≤ 0.95 if fully flooded with water borated to 850 ppm, which includes allowances for uncertainties as described in Section 9.11 of the FSAR;”

The analysis described in Enclosure 4 requires this proposed change. This change would be consistent with the requirement in TS 4.3.1.2c for Region II fuel storage racks.

TS 4.3.1.1d. would be renumbered as TS 4.3.1.1e and current TS 4.3.1.1c would be renumbered TS 4.3.1.1d as follows:

“A nominal 10.25 inch center to center distance between fuel assemblies with the exception of the single Type E rack, which has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies;”

The proposed change would also correct the description of the nominal center-to-center spacing for fuel storage rack E that is 11.25 inch by 10.69 inch, as described in TS Bases B 3.7.16. The dimensions were verified by review of the record drawing. The analysis in Enclosure 4 used the correct dimensions as input to the calculations. This proposed change also removed the connector “and” at the end of the section due to new sections being added to 4.3.1.1 as described below.

TS 4.3.1.1e. would be renumbered from TS 4.3.1.1d as follows:

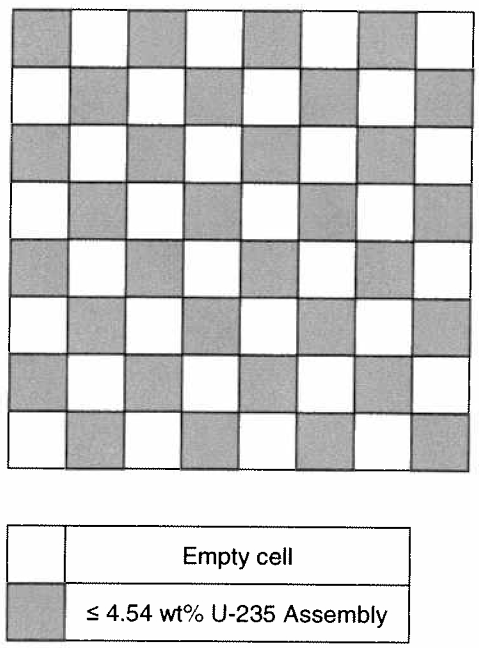
“New or irradiated fuel assemblies;”

To reflect the addition of new sections to TS 4.3.1.1, the proposed change would remove the period at the end of the sentence and would add a semi-colon.

New sections to TS 4.3.1.1f though 4.3.1.1j are proposed below. The proposed changes are supported by the analysis in Enclosure 4. These proposed changes are significantly different from NUREG-1432 due to the unique aspects of the fuel and non-fissile bearing component storage restrictions for Region I of the spent fuel pool.

New TS 4.3.1.1f would be added and read as follows:
"Region 1A is defined as the Region I storage racks located in the main spent fuel pool and are subject to the following restriction. All fuel located in Region 1A shall be in a two-of-four checkerboard loading pattern with empty cells as shown in the figure below. Region 1A fuel is limited to those assemblies having a nominal planar average U-235 enrichment of less than or equal to 4.54 weight percent. Region 1A shall not contain any face adjacent fuel assemblies. Restrictions for non-fissile bearing components are described in section 4.3.1.1j below;"

Fuel Loading Pattern for Region 1A

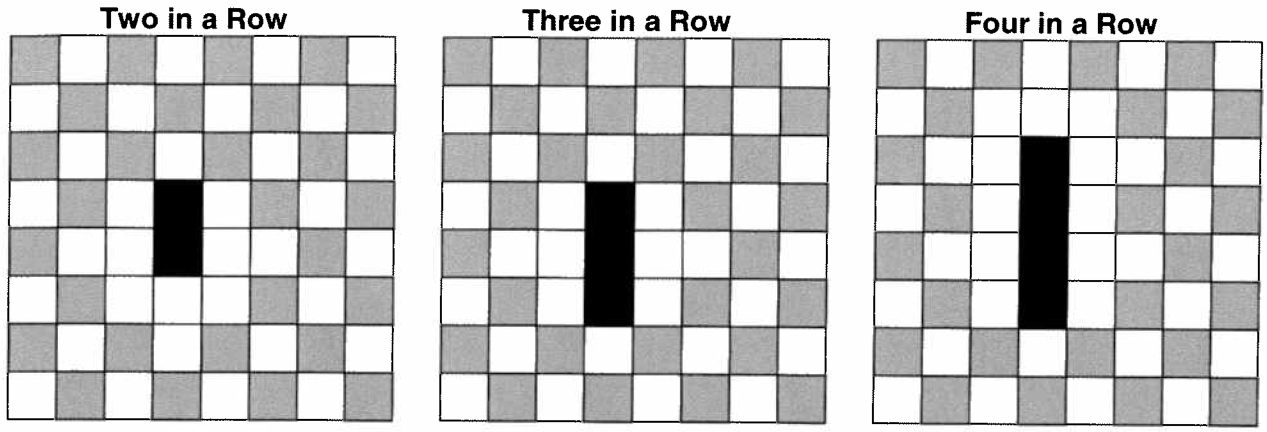


New TS 4.3.1.1g would be added and read as follows:

"Region 1B is defined as the Region I storage racks located in the main spent fuel pool with face adjacent fuel that is surrounded by empty face adjacent cells. Region 1B fuel is limited to those assemblies having a nominal planar average U-235 enrichment of less than or equal to 4.34 weight percent. Region IA cells that are diagonally adjacent to Region 1B may contain fuel assemblies provided conditions of Section 4.3.1.1f, 4.3.1.1g.1 and 4.3.1.1g.2 are met. Restrictions for non-fissile bearing components are described in section 4.3.1.1j below. Additional geometric conditions on Region 1B are:

1. Up to four face adjacent fuel assemblies in a single contiguous row are allowed as shown in the figures below. All other face adjacent cells shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below.

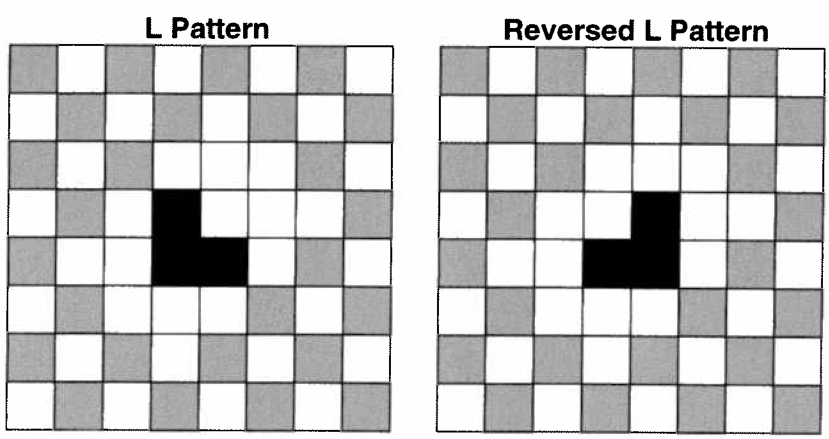
Region 1B Patterns for Four or Fewer Face Adjacent Assemblies in a Row



(white)	Empty cell
(grey)	≤ 4.54 wt% U-235 Assembly
(black)	≤4.34 wt% U-235 Assembly

2. Three face adjacent fuel assemblies forming an L pattern are allowed as shown in the figures below. All face adjacent cells surrounding the two-by-two block containing the L pattern shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below;"

Region 1B Patterns for Three in an L



(white)	Empty cell
(grey)	≤ 4.54 wt% U-235 Assembly
(black)	≤4.34 wt% U-235 Assembly

New TS 4.3.1.1h would be added and read as follows:

"Interface Requirements for the Main Spent Fuel Pool

1. Region I fuel racks that have cells that occupy locations F24 through U24 of the Main Spent Fuel Pool are adjacent to fuel racks in Region II of the Main Spent Fuel Pool. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells.

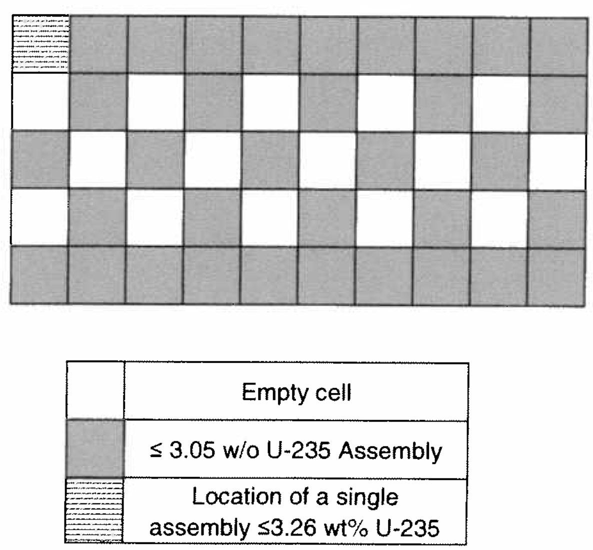
2. There are twelve locations adjacent to the area that contains the elevator and inspection station. These locations are I1, I2, I3, J3, K3, L3, M3, N3, O3, P1, P2, and P3. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells;"

New TS 4.3.1.1i would be added and read as follows:

"Region 1E is defined as the Region I storage rack located in the north tilt pit. Region 1E shall maintain the selective loading pattern as shown in the figure below. This selective loading pattern allows for one fuel assembly having a nominal planar average U-235 enrichment of less than or equal to 3.26 weight percent. This assembly shall be placed in the southwest corner location of the rack. All 34 other allowed fuel locations in the figure below are limited to a nominal planar average U-235 enrichment of less than or equal to 3.05 weight percent. The remaining fifteen cells shall be empty; and"

Region 1E Allowed Fuel Storage Pattern

North →



New TS 4.3.1.1j would be added and read as follows:

"Non-Fissile Bearing Components and restrictions are defined as follows:

1. Non-fissile material component may be stored in any designated fuel location in Region 1A, 1B, or 1E without restriction.

2. The following non-fuel bearing components (NFBC) may be stored face adjacent to fuel in designated empty cells in Region 1A or 1B, except for interface locations described above in 4.3.1.1h.

    a. The gauge dummy assembly and the lead dummy assembly may be stored anywhere in Region 1A or 1B.

    b. An assembly comprised of up to 216 solid stainless steel (SS) rods may be stored face adjacent to fuel in a designated empty cell as long as the NFBC is at least ten locations away from another NFBC that is face adjacent to a fuel assembly. Locations within this NFBC assembly not containing SS rod(s) shall be left empty, or

    c. A component comprised primarily of SS that displaces less than 30 square inches in any horizontal plane within the active fuel region may be stored face adjacent to fuel, in a designated empty cell, as long as the NFBC is at least ten locations away from another NFBC that is face adjacent to a fuel assembly.

3. Non-fissile bearing components shall not be stored in designated empty cells in Region 1E."

3.0 BACKGROUND

In July 2008, ENO identified that results from Boron-10 Areal Density Gage for Evaluating Racks (BADGER) testing, of the Region I spent fuel pool (SFP) storage racks, indicated that the neutron absorber material contained less boron-10 than assumed in the spent fuel pool criticality analysis of record. The neutron absorber in the Region I SFP and north tilt pit storage racks is relied on for compliance with TS 4.3.1.1b criticality requirements. TS 4.3.1.1b requires that Keff for Region I fuel racks be less than or equal to 0.95 if fully flooded with unborated water. With soluble boron required to maintain a Keff less than or equal to 0.95 in the Region I fuel racks, PNP no longer was in compliance with the TS requirement or 10 CFR 50.68. In accordance with NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety," compensatory measures were taken. This LAR supports permanent resolution of the nonconformance.

The SFP contains storage racks that are designated as Region I and Region II. The Region I storage racks contain Carborundum® neutron absorber plates. The Region II racks contain a neutron absorbing material, Boraflex, that is not credited in the Region II criticality calculations (refer to PNP license amendment No. 207, Accession No. ML020590151). Soluble boron, at 850 ppm, is required by TS 4.3.1.2c to maintain Keff less than or equal to 0.95 in the Region II storage racks when fully flooded with water.

ENO submitted a letter dated August 27, 2008 (ML082410132), describing four commitments and plans for a LAR to address the degraded SFP storage rack neutron absorber. Licensee Event Report 08-004, dated September 15, 2008 (ML082660584), described the noncompliance with TS 4.3.1.1b. and 10 CFR 50.68. The NRC issued a Confirmatory Action Letter (CAL) on September 18, 2008 (ML082630145), confirming commitments by ENO in the August 27, 2008, letter. The CAL also indicated a LAR submittal is needed to restore regulatory compliance prior to the next refueling outage.

4.0 TECHNICAL ANALYSIS

Region I Criticality Evaluation

AREVA NP Inc. report, Document No. ANP-2779NP-001, "Palisades SFP Region 1 Criticality Evaluation," (Enclosure 4) provides the technical analysis for the proposed change to store fuel up to a maximum nominal planar average 4.54 weight percent U-235 in the existing Region I. ENO has reviewed and accepted this report.

Key elements of the report are as follows:

Major Assumptions

- No credit was taken for burnup.
- No credit is taken for intermediate spacer grids or end fittings.
- No credit is taken for any boron in the Carborundum® poison plates.
- The maximum fuel enrichment tolerance of 0.05 wt% is considered in the tolerance evaluation. Other tolerances, for both fuel and rack parameters, were evaluated at both their positive and negative extremes. To be conservative, only positive impacts upon Keff (from the base model) were used in the compilation of the uncertainties.
- All Carborundum® poison plates are assumed swelled by replacing a thickness of 0.54 inches of water that surrounds each absorber plate with voids. See section 3.3.4 of ANP-2779NP-001 for further detail.
- No removable control components in the fuel are credited in the analysis.
- Credit is taken for soluble boron.
- Credit is taken for certain storage cells remaining empty of fissile material.

Methodology
The KENO-V.a computer code, a part of the SCALE4.4a package, was used exclusively for computational analyses. Extensive benchmarking of KENO is described in Appendix A of the report. The report analyzed the impact of the change of Region I on the Region II fuel storage racks and the resultant interfaces within and between the racks in each Region. The analysis does not affect other PNP fuel handling systems.

Additional Conservatisms
Section 4.2.3 of the ANP-2779NP-001 report provides a qualitative summary of some of the conservatisms inherent in the assumptions of these analyses.

Results
The results of the analysis determined that the Region I racks have a Keff of less than 1.0, with the racks loaded with certain bounding nominal planar average enrichments, designated storage cells void of fuel, and racks flooded with unborated water at a temperature corresponding to the highest reactivity. The report demonstrated that Keff is less than or equal to 0.95 with the racks loaded with certain bounding nominal planar average enrichments and designated storage cells void of fuel, and flooded with borated water at a temperature corresponding to the highest reactivity. Thus, compliance with 10 CFR 50.68 is restored. Also, reactivity effects of abnormal and accident conditions (mis-loaded fuel) will not result in Keff exceeding the regulatory limit of 0.95 under borated conditions.

This LAR also proposes to correct an omission in the description of fuel storage rack E that has a nominal center to center spacing of 11.25 inch by 10.69 inch. The current TS 4.3.1.1c statement that the center to center spacing is 11.25 inch is incorrect. This statement has been in the design features section of the TS since issuance of license Amendment 49 on May 29, 1979. TS Bases section B 3.7.16 contains the correct 11.25 inch by 10.69 inch center to center dimensions that were confirmed against the record drawing. The enclosed analysis in Enclosure 4 incorporates the correct storage rack E dimensions as indicated in Table 3-2.

Summary of boron dilution evaluation
Consumers Energy (the former owner and license holder) submitted a March 2, 2001, amendment request for the spent fuel pool boron concentration. The amendment request and supplements provided the basis for NRC issuance of Amendment 207 to the Palisades Operating License, allowing changes to enrichment limits in the spent fuel pool. The amendment request provided a spent fuel pool boron dilution evaluation. The evaluation has been reviewed and remains valid. In summary, available dilution sources were compiled and analyzed against the calculated dilution volumes to determine the potential of a spent fuel pool boron dilution event. For each dilution scenario, calculations were performed to define the dilution time for the spent fuel pool to reach 850 ppm.

The evaluation shows that a large volume of water (123,007 gallons) is necessary to dilute the spent fuel pool from the present TS limit of 1720 ppm to a soluble boron concentration where a Keff of 0.95 would be approached in the pool. For the limiting dilution source flow rate, the dilution time to reach a pool concentration of 850 ppm was determined to be 9.8 hours. The first 15,000 gallons of dilution water would fill the pool to its overflow level. The remaining 107,600 gallons needed to dilute the pool to 850 ppm would all be over boarded onto the pool deck and down the equipment hatch, elevator shaft, or the stair well, all of which are located within 4 to 10 feet of the pool. The resulting water distribution throughout the auxiliary building and safeguards room basement would result in high sump level alarms in the control room. The large amounts of water on the floor would be easily spotted by the operators whether they have specifically been sent there in response to an alarm or if they were making normal rounds through the aux building and fuel pool on a shiftly basis. Therefore, it is reasonable to assume that the operators will recognize and terminate this event well before the boron concentration in the spent fuel pool drops below 850 ppm at 9.8 hours into the event. A fuel pool high level alarm would give an even earlier warning of fuel pool level increases that could lead to dilution of the soluble boron concentration.

Abnormal Conditions and the Double-Contingency Principle

NRC Memorandum from L. Kopp to T. Collins dated August 19, 1998, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants" includes the following summary of abnormal conditions and the double-contingency principle:

> The criticality safety analysis should consider all credible incidents and postulated accidents. However, by virtue of the double-contingency principle, two unlikely independent and concurrent incidents or postulated accidents are beyond the scope of the required analysis. The double-contingency principle means that a realistic condition may be assumed for the criticality analysis in calculating the effects of incidents or postulated accidents. For example, if soluble boron is normally present in the spent fuel pool water, the loss of soluble boron is considered as one accident condition and the second concurrent accident need not be assumed. Therefore, credit for the presence of the soluble boron may be assumed in evaluating other accident conditions.

The proposed changes support compliance with this principle.

Human Performance

The current process for moving fuel assemblies is controlled by system operating procedure SOP-28, "Fuel Handling System." The procedure provides the detailed steps associated with the equipment controls on the fuel handling machines, as well as the required communications necessary between the fuel handling machine operator and the fuel handling communicator (FHC).

Fuel move plans are developed by experienced and qualified reactor engineering personnel. Engineering Manual procedure EM-04-29, "Guidelines for Preparing Fuel Movement Plans," is the governing document for preparation of fuel move plans. The procedure also requires an independent review by another qualified reactor engineer.

The procedure has recently been revised to ensure the preparer references the applicable technical basis requirements associated with the September 18, 2008, Confirmatory Action Letter, to ensure criticality margins are maintained in the spent fuel pool when moving fuel assemblies.

A human performance work practice includes annotating unique conditions associated with specific fuel moves with clarifying notes in the comment field or elsewhere on the fuel move sheets. These notes would include additional process controls established to minimize the probability of a fuel move error. These notes are discussed during the pre-job brief. For example, a note could be included on applicable fuel move sheets to visually verify that the four face adjacent locations do not contain fuel prior to lowering a fuel assembly.

Fuel moves are coordinated and independently verified by a qualified reactor engineer FHC. The Palisades fuel handling machine has specific storage cell coordinates that are pre-programmed into the spent fuel handling machine (SFHM) computer. This is a physical control that results in less chance for fuel move errors in Region I fuel storage rack C, proposed Region 1A or 1B. For each fuel move, these coordinates are verified by the FHC. For fuel storage rack E locations, proposed Region 1E, which do not have cell coordinates in the SFHM computer, SOP-28 requires the FHC to verify the cell location identified by the fuel handling machine operator.

The following human performance tools are used during fuel handling;

1. Three-way communications between the fuel handling machine operator and the FHC is used during verification of "from" and "to" locations, and during verification of fuel handling machine mast orientation.

2. Place-keeping on the fuel moves sheets is required for each fuel move step.

3. The performance of fuel move evolutions is preceded with formal pre-job briefs. Recent pre-job briefing to support fuel moves from Region I to Region II fuel storage racks included review of specific fuel movement error events at Palisades and other plants as described in the Institute of Nuclear Power Operations topical report TR6-53 "Fuel Handling Events."

There are approximately 150 fuel moves planned for setup of the SFP for future expected fuel storage restrictions. The fuel moves are not different from fuel moves previously performed, and the above controls are considered appropriate to minimize the probability of the occurrence of a fuel misload event.

<u>Conclusion</u>

ENO has reviewed these human performance practices and determined they are consistent with industry guidance for preventing fuel handling errors.

5.0 REGULATORY SAFETY ANALYSIS

5.1 No Significant Hazards Consideration

Entergy Nuclear Operations, Inc. (ENO) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment to the spent fuel assembly storage in Technical Specification (TS) 3.7.16 and the fuel storage criticality requirements in section 4.3.1.1 of the TS, using the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

There is no significant increase in the probability of an accidental misloading of fuel assemblies into the spent fuel pool racks when considering the presence of soluble boron in the pool water for criticality control. Fuel assembly placement would continue to be controlled by approved fuel handling procedures and would be in accordance with the TS fuel storage rack configuration limitations.

There is no significant increase in the consequences of the accidental misloading of fuel assemblies into the spent fuel pool racks because the criticality analyses demonstrate that the pool would remain subcritical with margin following an accidental misloading if the pool contains an adequate boron concentration. The TS 3.7.15 limitation on minimum spent fuel pool boron concentration and plant procedures ensure that an adequate boron concentration will be maintained.

There is no significant increase in the probability of a fuel assembly drop accident in the spent fuel pool when considering the presence of soluble boron in the spent fuel pool water for criticality control. The handling of fuel assemblies in the spent fuel is performed in borated water. The criticality analysis has showed the reactivity increase with a fuel assembly drop accident in both a vertical and horizontal orientation is bounded by the misloading accident. Therefore, the consequences of a fuel assembly drop accident in the spent fuel pool would not increase significantly due to the proposed change.

The spent fuel pool TS boron concentration requirement In TS 3.7.15 requires a minimum of 1720 ppm which bounds the analysis. Soluble boron has been maintained in the spent fuel pool water as required by TS and controlled by procedures. The present criticality safety analyses for Region II of the spent fuel pool credits the same soluble boron concentration of 850 ppm to maintain a Keff ≤ 0.95 under normal conditions and 1350 ppm to maintain a Keff ≤ 0.95 under accident scenarios as do the analyses for the proposed change for Region 1. Crediting soluble boron in the Region 1 spent fuel pool criticality analysis would have no effect on normal pool operation and maintenance. Thus, there is no change to the probability or the consequences of the boron dilution event in the spent fuel pool.

Since soluble boron is maintained in the spent fuel pool water, implementation of the proposed changes would have no effect on the normal pool operation and maintenance. Also, since soluble boron is present in the spent fuel pool a dilution event has always been a possibility. The loss of substantial amounts of soluble boron from the spent fuel pool was evaluated as part of the analyses in support of this proposed amendment. The analyses use the same soluble boron concentrations as were used in previous analyses for Region II spent fuel storage racks. In the unlikely event that soluble boron in the spent fuel pool is completely diluted, the fuel in Region 1 of the spent fuel pool would remain subcritical by a design margin of at least 0.02 delta K, so the Keff of the fuel in Region 1 will remain below 1.0. Therefore, the limitations on boron concentration have not changed and would not result in a significant increase in the probability or consequences of a previously evaluated accident.

There is no increase in the probability or consequences of the loss of normal cooling to the spent fuel pool water, when considering the presence of soluble boron in the pool water for subcriticality control, since a high concentration of soluble boron is always maintained in the spent fuel pool.

The criticality analyses documented in AREVA NP report ANP-2779NP-001, "Palisades SFP Region 1 Criticality Evaluation," show, at a 0.95% probability and a 95% confidence level (95/95) that Keff is less than the regulatory limit in 10 CFR 50.68 of 0.95 under borated conditions, or a limit of 1.0 with unborated water. Therefore, the consequences of accidents previously evaluated are not increased.

Therefore, it is concluded that the proposed change does not significantly increase the probability or consequences of any accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

Spent fuel handling accidents have been analyzed in Sections 14.11, "Postulated Cask Drop Accidents," and 14.19, "Fuel Handling Incident," of the Updated Final Safety Analysis Report. Criticality accidents in the spent fuel pool have been analyzed in previous criticality evaluations, which are the bases for the present TS.

The existing TS allow storage of fuel assemblies with a maximum planar average U-235 enrichment of 4.95 weight percent in the Region I fuel storage rack. The proposed specifications would restrict fuel enrichment to lower values in different areas of the Region I storage racks. The possibility of placing a fuel assembly with greater enrichment than allowed currently exists but is controlled by fuel manufacturer's procedures and plant handling procedures. Manufacturer's and plant procedual controls would remain in place. Lowering the allowed enrichments does not create a new or different kind of accident.

ENO considered the effects of a mispositioned fuel assembly. The proposed loading restrictions include locations that are prohibited from containing any fuel. Administrative controls are in place to restrict fuel moves to those locations. These include procedures to develop the plans for fuel movement and operate the fuel handling equipment. These procedures include appropriate reviews and verifications to ensure design requirements are maintained. ENO is also proposing to add new limiting conditions for operation and surveillance requirements in TS 3.7.16 to provide additional assurance that the requirements are met.

Furthermore, the existing TS contain limitations on the spent fuel pool boron concentration that conservatively bound the required boron concentration of the new criticality analyses. Currently, TS 3.7.15 requires a minimum boron concentration of 1720 ppm. Since soluble boron is maintained in the spent fuel pool water, implementation of the proposed changes would have no effect on the normal pool operation and maintenance. Since soluble boron is present in the spent fuel pool, a dilution event has always been a possibility. The loss of substantial amounts of soluble boron from the spent fuel pool was evaluated as part of the analysis in support of Amendment 207. That analysis also demonstrated that due to the large volume of unborated water that would need to be added and displaced, and the long duration of the event, the condition would be detected and corrected promptly. The analyses that support the current request use the same soluble boron concentrations as were used in previous analyses for Region II spent fuel storage racks. In the unlikely event that soluble boron in the spent fuel pool is completely diluted, the fuel in Region 1 of the spent fuel pool would remain subcritical by a design margin of at least 0.02 delta K, so the Keff of the fuel in Region 1 would remain below 1.0.

The combination of controls to prevent a mispositioned fuel assembly, ability to readily identify and correct a dilution event, and relatively high concentration of soluble boron supports a conclusion that a new or different kind of accident is not created.

Under the proposed amendment, no changes are made to the fuel storage racks themselves, to any other systems, or to any plant structures. Therefore, the change will not result in any other change in the plant configuration or equipment design.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No.

Detailed analysis with approved and benchmarked methods has shown with a 95% probability at a 95% confidence level, that the Keff, of the Region 1 fuel storage racks in the spent fuel pool, including biases, tolerances and uncertainties is less than 1.0 with unborated water, and less than or equal to 0.95 with 850 ppm of soluble boron credited. In addition, the effects of abnormal and accident conditions have been evaluated to demonstrate that under credible conditions the Keff will not exceed 0.95 with 1350 ppm soluble boron credited. The current TS requirement for minimum spent fuel pool boron concentration is 1720 ppm, which provides assurance that the spent fuel pool would remain subcritical.

The current analysis basis for the Region II fuel storage racks is a maximum Keff of less than 1.0 when flooded with unborated water, and less than or equal to 0.95 when flooded with water having a boron concentration of 850 ppm. In addition, the Keff in accident or abnormal operating conditions is less than 0.95 with 1350 ppm of soluble boron. These values are not affected by the proposed change.

Therefore, it is concluded that the proposed change does not involve a significant reduction in the margin of safety.

Conclusion

Based on the evaluation above, ENO concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

The SFP storage racks maintain fresh and irradiated assemblies in a safe storage condition. The federal code requirements in the Code of Federal Regulations, Title10, Part 50, Section 50.68 (10 CFR 50.68) specify the normal and accident parameters associated with maintaining fresh and irradiated fuel assemblies in a safe storage condition. 10 CFR 50.68 defines the criticality accident requirements associated with the fuel storage racks and states the following: "If credit is taken for soluble boron, the Keff of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95% probability, 95% confidence level, if flooded with borated water, and the Keff must remain below 1.0 (subcritical), at a 95% probability, 95% confidence level, if flooded with unborated water."

The current analysis for Region II (refer to License Amendment No. 207, dated February 26, 2002, ML020440048) is based on a maximum Keff of less than 1.0 when flooded with unborated water, and less than or equal to 0.95 when flooded with water having a boron concentration of 850 ppm. In addition, the Keff in accident or abnormal operating conditions is less than 0.95 with 1350 ppm of soluble boron.

The evaluation in Enclosure 4 provides results of analyses for Region I that demonstrate the Keff is less than 1.0 with the racks loaded with fuel of the highest anticipated reactivity, and flooded with unborated water at a temperature corresponding to the highest reactivity. In addition, the analyses demonstrate that Keff is less than or equal to 0.95 with the racks loaded with fuel of the highest anticipated reactivity, and flooded with borated water at a temperature corresponding to the highest reactivity. The maximum calculated reactivity included a margin for uncertainty in reactivity calculations including manufacturing tolerances and is shown to be less than 0.95 with a 95% probability at a confidence level with boron credit. Reactivity effects of abnormal and accident conditions were also evaluated to assure that under all credible abnormal and accident conditions, the reactivity will not exceed the regulatory limit of 0.95 under borated conditions or a limit of 1.0 with unborated water. The double-contingency principle of ANS-8.1/N16.1-1975 and NRC letter of April 14, 1978, specify that it shall require at least two unlikely, independent and concurrent events before a criticality accident is possible. This principle precludes the necessity of considering the simultaneous occurrence of multiple accident conditions.

The following applicable codes, standard and regulations or pertinent sections thereof, were used in the analyses described in Enclosure 4:

- 10 CFR 50, Appendix A, General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling"
- 10 CFR 50.68, "Criticality accident requirements"
- NUREG-0800 "Standard Review Plan," Section 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage and Handling," Revision 3, March 2007
- USNRC letter to all Power Reactor Licensees dated April 14, 1978, Enclosure No. 1, "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications" (GL-78-011), including modification letter dated January 18, 1979 (GL-79-004)
- NRC Memorandum from L. Kopp to T. Collins dated August 19, 1998, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants"
- Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," Revision 2, March 2007
- ANSI ANS-8.17-1984, "Criticality Safety Criteria for the Handling, Storage and Transportation of LWR Fuel Outside Reactors"
- NUREG/CR-6698 "Guide for Validation of Nuclear Criticality Safety Methodology"

6.0 ENVIRONMENTAL CONSIDERATION

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. NRC letter issuing Amendment No. 207 to Palisades Facility Operating License dated February 26, 2002 (Accession Nos. ML020440048 & ML020590151)

2. Consumers Energy letter to the NRC, dated March 2, 2001, "Technical Specifications Change Request Spent Fuel Pool Boron Concentration" (Accession No. 010680047)

ENCLOSURE 2

LICENSE AMENDMENT REQUEST FOR SPENT FUEL POOL REGION I CRITICALITY

REVISED TECHNICAL SPECIFICATION PAGES
Table of Contents page ii,
3.7.16-1 through 3.7.16-2
and
4.0-1 through 4.0-9

AND

RENEWED OPERATING LICENSE PAGE CHANGE INSTRUCTIONS

13 pages follow

ATTACHMENT TO LICENSE AMENDMENT NO.

RENEWED FACILITY OPERATING LICENSE NO. DPR-20

DOCKET NO. 50-255

Remove the following pages of Appendix A Technical Specifications and replace with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
Table of Contents page ii	Table of Contents page ii
Page 3.7.16-1 through 3.7.16-2	Page 3.7.16-1 through 3.7.16-2
Pages 4.0-1 through 4.0-4	Pages 4.0-1 through 4.0-7

3.7 PLANT SYSTEMS

3.7.16 Spent Fuel Pool Storage

LCO 3.7.16 Storage in the spent fuel pool shall be as follows:

a. Each fuel assembly and non-fissile bearing component stored in Region I shall be within the limitations in Specification 4.3.1.1; and

b. The combination of initial enrichment, burnup, and decay time of each fuel assembly stored in Region II shall be within the requirements of Table 3.7.16-1.

APPLICABILITY: Whenever any fuel assembly or non-fissile bearing component is stored in the spent fuel pool or the north tilt pit.

ACTIONS

---NOTE---

LCO 3.0.3 is not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	A.1 Initiate action to restore the noncomplying fuel assembly or non-fissile bearing component within requirements.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.16.1	Verify by administrative means each fuel assembly or non-fissile bearing component meets fuel storage requirements.	Prior to storing the fuel assembly or non-fissile bearing component in the spent fuel pool

TABLE 3.7.16-1 (page 1 of 1)

Spent Fuel Minimum Burnup and Decay Requirements
for Storage in Region II of the Spent Fuel Pool and North Tilt Pit

Initial Enrichment (Wt%)	Burnup (GWD/MTU) No Decay	Burnup (GWD/MTU) 1 Year Decay	Burnup (GWD/MTU) 3 Year Decay	Burnup (GWD/MTU) 5 Year Decay	Burnup (GWD/MTU) 8 Year Decay
≤ 1.14	0	0	0	0	0
> 1.14	3.477	3.477	3.477	3.477	3.477
1.20	3.477	3.477	3.477	3.477	3.477
1.40	7.951	7.844	7.464	7.178	6.857
1.60	11.615	11.354	10.768	10.319	9.847
1.80	14.936	14.535	13.767	13.187	12.570
2.00	18.021	17.502	16.561	15.875	15.117
2.20	21.002	20.417	19.313	18.499	17.611
2.40	23.900	23.201	21.953	21.034	20.050
2.60	26.680	25.905	24.497	23.487	22.378
2.80	29.388	28.528	27.006	25.879	24.678
3.00	32.044	31.114	29.457	28.243	26.942
3.20	34.468	33.457	31.698	30.397	29.008
3.40	36.848	35.783	33.920	32.544	31.079
3.60	39.152	38.026	36.059	34.615	33.077
3.80	41.419	40.226	38.163	36.650	35.049
4.00	43.661	42.422	40.257	38.673	37.007
4.20	45.987	44.684	42.415	40.778	39.028
4.40	48.322	46.950	44.588	42.877	41.041
4.60	50.580	49.158	46.690	44.911	43.003

(a) Linear interpolation between two consecutive points will yield acceptable results.

(b) Comparison of nominal assembly average burnup numbers to these in the table is acceptable if measurement uncertainty is ≤ 10%.

4.0 DESIGN FEATURES

4.1 Site Location

The Palisades Nuclear Plant is located on property owned by Entergy Nuclear Palisades, LLC on the eastern shore of Lake Michigan approximately four and one-half miles south of the southern city limits of South Haven, Michigan. The minimum distance to the boundary of the exclusion area as defined in 10 CFR 100.3 shall be 677 meters.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor core shall contain 204 fuel assemblies. Each assembly shall consist of a matrix of zircaloy-4 clad fuel rods with an initial composition of depleted, natural, or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. A core plug or plugs may be used to replace one or more fuel assemblies subject to the analysis of the resulting power distribution. Poison may be placed in the fuel bundles for long-term reactivity control.

4.2.2 Control Rod Assemblies

The reactor core shall contain 45 control rods. Four of these control rods may consist of part-length absorbers. The control material shall be silver-indium-cadmium, as approved by the NRC.

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The Region I fuel storage racks (See Figure B 3.7.16-1) incorporating Regions 1A, 1B, and 1E are designed and shall be maintained with:

a. Fuel assemblies having a maximum nominal planar average U-235 enrichment of 4.54 weight percent in Region 1A, 4.34 weight percent in region 1B, and 3.05 weight percent in Region 1E with the exception of one assembly in Region 1E, described in 4.3.1.1i below, having a maximum nominal planer average U-235 enrichment of 3.26 weight percent.

4.3 Fuel Storage

4.3.1 Criticality (continued)

b. K_{eff} < 1.0 if fully flooded with unborated water, which includes allowances for uncertainties as described in Section 9.11 of the FSAR;

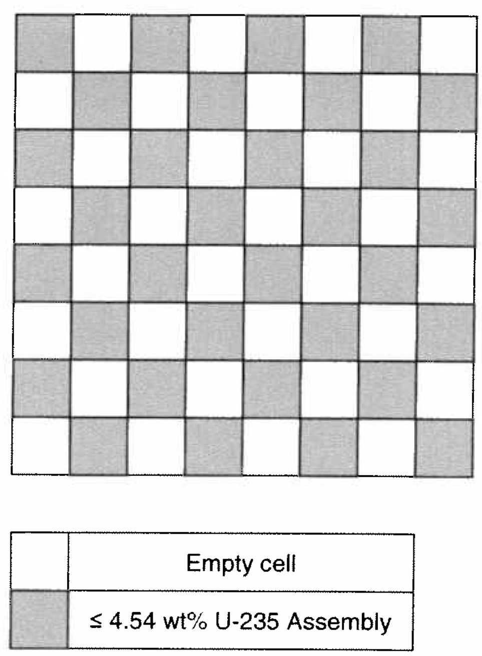
c. Keff ≤ 0.95 if fully flooded with water borated to 850 ppm, which includes allowances for uncertainties as described in Section 9.11 of the FSAR;

d. A nominal 10.25 inch center to center distance between fuel assemblies with the exception of the single Type E rack which has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies;

e. New or irradiated fuel assemblies;

f. Region 1A is defined as the Region I storage racks located in the main spent fuel pool and are subject to the following restriction. All fuel located in Region 1A shall be in a two-of-four checkerboard loading pattern with empty cells as shown in the figure below. Region 1A fuel is limited to those assemblies having a nominal planar average U-235 enrichment of less than or equal to 4.54 weight percent. Region 1A shall not contain any face adjacent fuel assemblies. Restrictions for non-fissile bearing components are described in section 4.3.1.1j below;

Fuel Loading Pattern for Region 1A



4.3 Fuel Storage

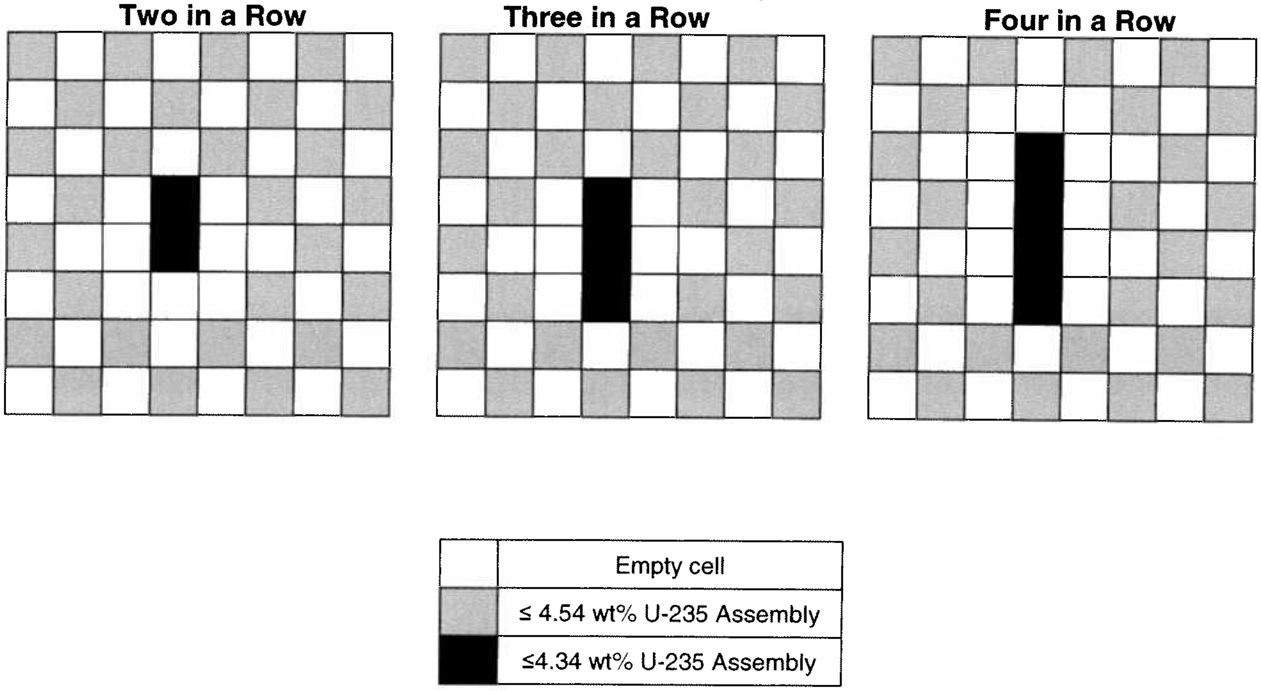
4.3.1 Criticality (continued)

g. Region 1B is defined as the Region I storage racks located in the main spent fuel pool with face adjacent fuel that is surrounded by empty face adjacent cells. Region 1B fuel is limited to those assemblies having a nominal planar average U-235 enrichment of less than or equal to 4.34 weight percent. Region IA cells that are diagonally adjacent to Region 1B may contain fuel assemblies provided conditions of Section 4.3.1.1f, 4.3.1.1g.1 and 4.3.1.1g.2 are met. Restrictions for non-fissile bearing components are described in section 4.3.1.1j below. Additional geometric conditions on Region 1B are:

1. Up to four face adjacent fuel assemblies in a single contiguous row are allowed as shown in the figures below. All other face adjacent cells shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below.

Region 1B Patterns for Four or Fewer Face Adjacent Assemblies in a Row

Two in a Row **Three in a Row** **Four in a Row**



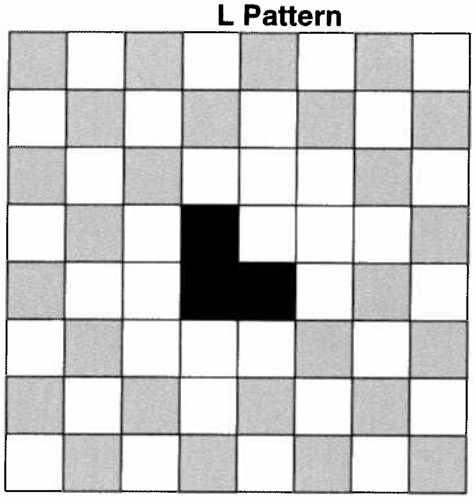
4.3 Fuel Storage

4.3.1 Criticality (continued)

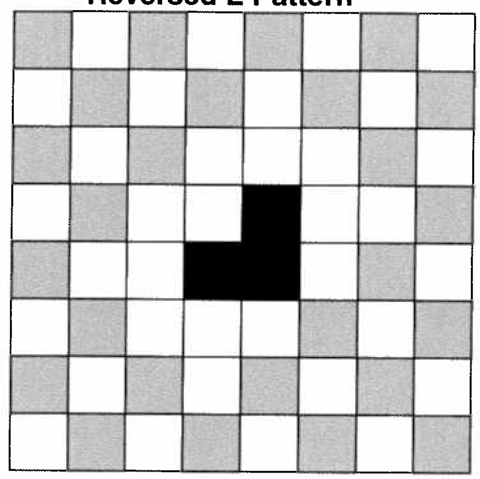
2. Three face adjacent fuel assemblies forming an L pattern are allowed as shown in the figures below. All face adjacent cells surrounding the two-by-two block containing the L pattern shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below;

Region 1B Patterns for Three in an L

L Pattern



Reversed L Pattern



(white)	Empty cell
(gray)	≤ 4.54 wt% U-235 Assembly
(black)	≤4.34 wt% U-235 Assembly

4.3 Fuel Storage

4.3.1 <u>Criticality</u> (continued)

h. Interface Requirements for the Main Spent Fuel Pool

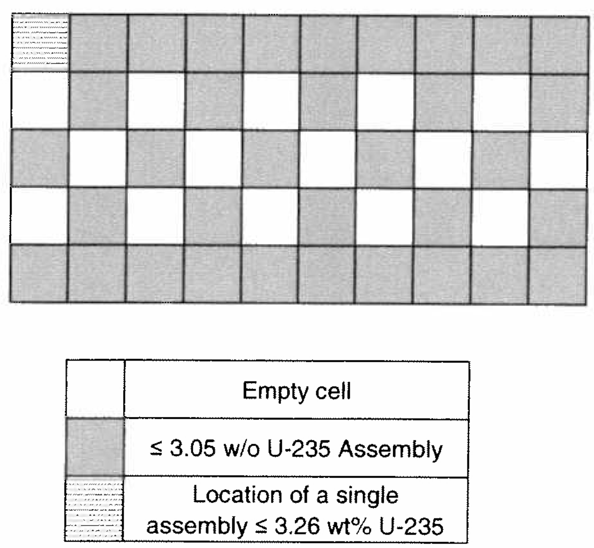
1. Region I fuel racks that have cells that occupy locations F24 through U24 of the Main Spent Fuel Pool are adjacent to fuel racks in Region II of the Main Spent Fuel Pool. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells.

2. There are twelve locations adjacent to the area that contains the elevator and inspection station. These locations are I1, I2, I3, J3, K3, L3, M3, N3, O3, P1, P2, and P3. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells;

i. Region 1E is defined as the Region I storage rack located in the north tilt pit. Region 1E shall maintain the selective loading pattern as shown in the figure below. This selective loading pattern allows for one fuel assembly having a nominal planar average U-235 enrichment of less than or equal to 3.26 weight percent. This assembly shall be placed in the southwest corner location of the rack. All 34 other allowed fuel locations in the figure below are limited to a nominal planar average U-235 enrichment of less than or equal to 3.05 weight percent. The remaining fifteen cells shall be empty; and

Region 1E Allowed Fuel Storage Pattern

North →



j. Non-Fissile Bearing Components and restrictions are defined as follows:

1. Non-fissile material component may be stored in any designated fuel location in Region 1A, 1B, or 1E without restriction.

2. The following non-fuel bearing components (NFBC) may be stored face adjacent to fuel in designated empty cells in Region 1A or 1B, except for interface locations described above in 4.3.1.1h.

   a. The gauge dummy assembly and the lead dummy assembly may be stored anywhere in Region 1A or 1B.

   b. An assembly comprised of up to 216 solid stainless steel (SS) rods may be stored face adjacent to fuel in a designated empty cell as long as the NFBC is at least ten locations away from another NFBC that is face adjacent to a fuel assembly. Locations within this NFBC assembly not containing SS rod(s) shall be left empty, or

   c. A component comprised primarily of SS that displaces less than 30 square inches of water in any horizontal plane within the active fuel region may be stored face adjacent to fuel, in a designated empty cell, as long as the NFBC is at least ten locations away from another NFBC that is face adjacent to a fuel assembly.

3. Non-fissile bearing components shall not be stored in designated empty cells in Region 1E.

4.3 Fuel Storage

4.3.1 Criticality (continued)

4.3.1.2 The Region II fuel storage racks (See Figure B 3.7.16-1) are designed and shall be maintained with;

a. Fuel assemblies having maximum planar average U-235 enrichment of 4.60 weight percent;

b. Keff < 1.0 if fully flooded with unborated water, which includes allowances for uncertainties as described in Section 9.11 of the FSAR.

c. $K_{eff} \leq 0.95$ if fully flooded with water borated to 850 ppm, which includes allowance for uncertainties as described in Section 9.11 of the FSAR.

d. A nominal 9.17 inch center to center distance between fuel assemblies; and

e. New or irradiated fuel assemblies which meet the initial enrichment, burnup, and decay time requirements of Table 3.7.16-1.

4.3.1.3 The new fuel storage racks are designed and shall be maintained with:

a. Twenty four unirradiated fuel assemblies having a maximum planar average U-235 enrichment of 4.95 weight percent, and stored in accordance with the pattern shown in Figure 4.3-1, or

Thirty six unirradiated fuel assemblies having a maximum planar average U-235 enrichment of 4.05 weight percent, and stored in accordance with the pattern shown in Figure 4.3-1;

b. Keff ≤ 0.95 when flooded with either full density or low density (optimum moderation) water including allowances for uncertainties as described in Section 9.11 of the FSAR.

4.3 Fuel Storage

4.3.1 Criticality (continued)

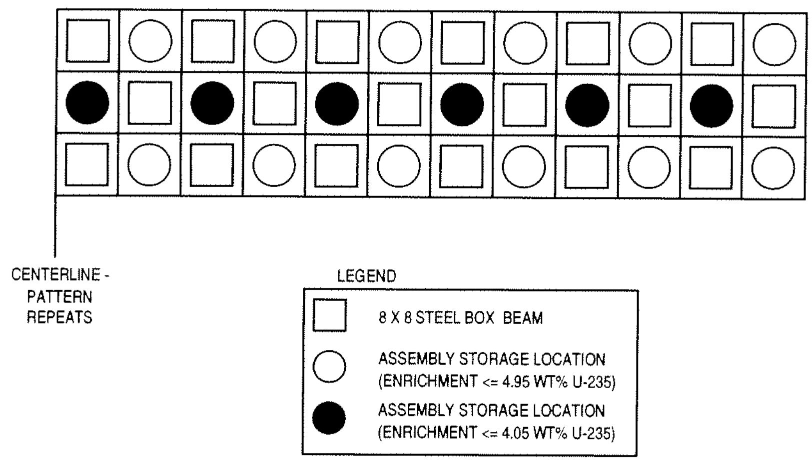
c. The pitch of the new fuel storage rack lattice being ≥ 9.375 inches and every other position in the lattice being permanently occupied by an 8" x 8" structural steel or core plugs, resulting in a nominal 13.26 inch center to center distance between fuel assemblies placed in alternating storage locations.

4.3.2 Drainage

The spent fuel storage pool cooling system suction and discharge piping is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 644 ft 5 inches.

4.3.3 Capacity

The spent fuel storage pool and north tilt pit are designed and shall be maintained with a storage capacity limited to no more than 892 fuel assemblies.



<u>Note:</u> If any assemblies containing fuel enrichments greater than 4.05% U-235 are stored in the New Fuel Storage Rack, the center row must remain empty.

Figure 4.3-1 (page 1 of 1)
New Fuel Storage Rack Arrangement

ENCLOSURE 3

LICENSE AMENDMENT REQUEST FOR SPENT FUEL POOL REGION I CRITICALITY

MARK-UP OF TECHNICAL SPECIFICATIONS PAGES

(showing proposed changes; additions are highlighted and deletions are strikethrough)

12 pages follow

3.7 PLANT SYSTEMS

3.7.16 Spent Fuel ~~Assembly~~ Pool Storage

LCO 3.7.16 ~~The combination of initial enrichment, burnup, and decay time of each fuel assembly stored in Region II shall be within the requirements of Table 3.7.16-1.~~Storage in the spent fuel pool shall be as follows:

a. Each fuel assembly and non-fissile bearing component stored in Region I shall be within the limitations in Specification 4.3.1.1; and

b. The combination of initial enrichment, burnup, and decay time of each fuel assembly stored in Region II shall be within the requirements of Table 3.7.16-1.

APPLICABILITY: Whenever any fuel assembly ~~is stored in Region II of either~~ or non-fissile bearing component is stored in the spent fuel pool or the north tilt pit.

ACTIONS

---NOTE---

LCO 3.0.3 is not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Requirements of the LCO not met.	A.1 Initiate action to ~~move~~ restore the noncomplying fuel assembly or non-fissile bearing component within requirements ~~from Region II~~.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.16.1	Verify by administrative means ~~the combination of initial enrichment, burnup, and decay time of the~~ each fuel assembly ~~is in accordance with Table 3.7.16-1~~or non-fissile bearing component meets fuel storage requirements.	Prior to storing the fuel assembly ~~in Region II~~ or non-fissile bearing component in the spent fuel pool

TABLE 3.7.16-1 (page 1 of 1)

Spent Fuel Minimum Burnup and Decay Requirements
for Storage in Region II of the Spent Fuel Pool and North Tilt Pit

Initial Enrichment (Wt%)	Burnup (GWD/MTU) No Decay	Burnup (GWD/MTU) 1 Year Decay	Burnup (GWD/MTU) 3 Year Decay	Burnup (GWD/MTU) 5 Year Decay	Burnup (GWD/MTU) 8 Year Decay
≤ 1.14	0	0	0	0	0
> 1.14	3.477	3.477	3.477	3.477	3.477
1.20	3.477	3.477	3.477	3.477	3.477
1.40	7.951	7.844	7.464	7.178	6.857
1.60	11.615	11.354	10.768	10.319	9.847
1.80	14.936	14.535	13.767	13.187	12.570
2.00	18.021	17.502	16.561	15.875	15.117
2.20	21.002	20.417	19.313	18.499	17.611
2.40	23.900	23.201	21.953	21.034	20.050
2.60	26.680	25.905	24.497	23.487	22.378
2.80	29.388	28.528	27.006	25.879	24.678
3.00	32.044	31.114	29.457	28.243	26.942
3.20	34.468	33.457	31.698	30.397	29.008
3.40	36.848	35.783	33.920	32.544	31.079
3.60	39.152	38.026	36.059	34.615	33.077
3.80	41.419	40.226	38.163	36.650	35.049
4.00	43.661	42.422	40.257	38.673	37.007
4.20	45.987	44.684	42.415	40.778	39.028
4.40	48.322	46.950	44.588	42.877	41.041
4.60	50.580	49.158	46.690	44.911	43.003

(a) Linear interpolation between two consecutive points will yield acceptable results.

(b) Comparison of nominal assembly average burnup numbers to these in the table is acceptable if measurement uncertainty is ≤ 10%.

4.0 DESIGN FEATURES

4.1 Site Location

The Palisades Nuclear Plant is located on property owned by Entergy Nuclear Palisades, LLC on the eastern shore of Lake Michigan approximately four and one-half miles south of the southern city limits of South Haven, Michigan. The minimum distance to the boundary of the exclusion area as defined in 10 CFR 100.3 shall be 677 meters.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor core shall contain 204 fuel assemblies. Each assembly shall consist of a matrix of zircaloy-4 clad fuel rods with an initial composition of depleted, natural, or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. A core plug or plugs may be used to replace one or more fuel assemblies subject to the analysis of the resulting power distribution. Poison may be placed in the fuel bundles for long-term reactivity control.

4.2.2 Control Rod Assemblies

The reactor core shall contain 45 control rods. Four of these control rods may consist of part-length absorbers. The control material shall be silver-indium-cadmium, as approved by the NRC.

4.3 Fuel Storage

4.3.1 Criticality

4.3.1.1 The Region I fuel storage racks (See Figure B 3.7.16-1) incorporating Regions 1A, 1B, and 1E are designed and shall be maintained with:

a. Fuel assemblies having a maximum nominal planar average U-235 enrichment of 4.54 weight percent in Region 1A, 4.34 weight percent in Region 1B, and 3.05 weight percent in Region 1E with the exception of one assembly in Region 1E, described in 4.3.1.1i below, having a maximum nominal planar average U-235 enrichment of 3.26 weight percent;

4.0 DESIGN FEATURES

4.3 Fuel Storage

4.3.1 Criticality (continued)

b. K_{eff} ~~≤ 0.95~~ < 1.0 if fully flooded with unborated water, which includes allowances for uncertainties as described in Section 9.11 of the FSAR~~.~~[redacted]

[redacted] Keff ≤ 0.95 if fully flooded with water borated to 850 ppm, which includes allowances for uncertainties as described in Section 9.11 of the FSAR;

d. A nominal 10.25 inch center to center distance between fuel assemblies with the exception of the single Type E rack which has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies; ~~and~~

INSERT 1

[redacted] New or irradiated fuel assemblies~~.~~[redacted]

Move to page 4.0-7 and 4.3.1.3b. on next page

4.3.1.2 The Region II fuel storage racks (See Figure B 3.7.16-1) are designed and shall be maintained with;

a. Fuel assemblies having maximum planar average U-235 enrichment of 4.60 weight percent;

b. Keff < 1.0 if fully flooded with unborated water, which includes allowances for uncertainties as described in Section 9.11 of the FSAR.

c. K_{eff} ≤ 0.95 if fully flooded with water borated to 850 ppm, which includes allowance for uncertainties as described in Section 9.11 of the FSAR.

d. A nominal 9.17 inch center to center distance between fuel assemblies; and

e. New or irradiated fuel assemblies which meet the initial enrichment, burnup, and decay time requirements of Table 3.7.16-1.

4.3.1.3 The new fuel storage racks are designed and shall be maintained with:

a. Twenty four unirradiated fuel assemblies having a maximum planar average U-235 enrichment of 4.95 weight percent, and stored in accordance with the pattern shown in Figure 4.3-1, or

Thirty six unirradiated fuel assemblies having a maximum planar average U-235 enrichment of 4.05 weight percent, and stored in accordance with the pattern shown in Figure 4.3-1;

4.0 DESIGN FEATURES

To pg. 4.0-7

b. Keff ≤ 0.95 when flooded with either full density or low density (optimum moderation) water including allowances for uncertainties as described in Section 9.11 of the FSAR.

4.3 Fuel Storage

4.3.1 Criticality (continued)

c. The pitch of the new fuel storage rack lattice being ≥ 9.375 inches and every other position in the lattice being permanently occupied by an 8" x 8" structural steel or core plugs, resulting in a nominal 13.26 inch center to center distance between fuel assemblies placed in alternating storage locations.

4.3.2 Drainage

The spent fuel storage pool cooling system suction and discharge piping is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 644 ft 5 inches.

4.3.3 Capacity

The spent fuel storage pool and north tilt pit are designed and shall be maintained with a storage capacity limited to no more than 892 fuel assemblies.

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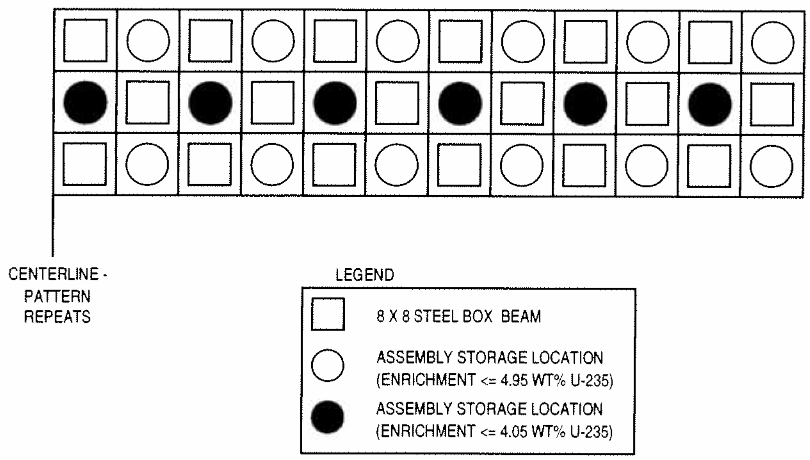
4.0 DESIGN FEATURES



Note: If any assemblies containing fuel enrichments greater than 4.05% U-235 are stored in the New Fuel Storage Rack, the center row must remain empty.

Figure 4.3-1 (page 1 of 1)
New Fuel Storage Rack Arrangement

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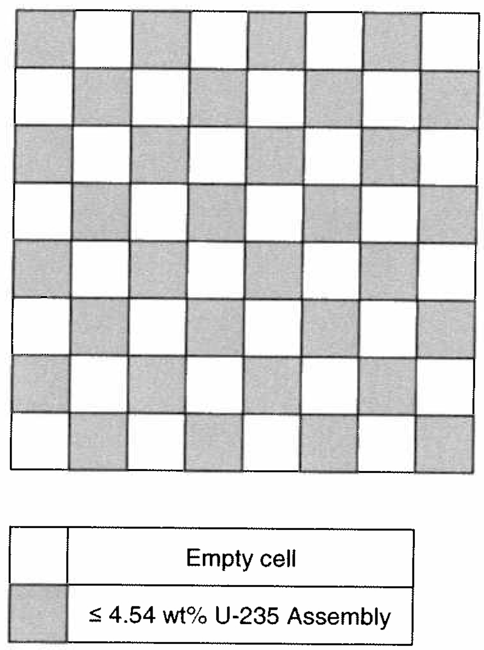
INSERT 1

f. Region 1A is defined as the Region I storage racks located in the main spent fuel pool and are subject to the following restriction. All fuel located in Region 1A shall be in a two-of-four checkerboard loading pattern with empty cells as shown in the figure below. Region 1A fuel is limited to those assemblies having a nominal planar average U-235 enrichment of less than or equal to 4.54 weight percent. Region 1A shall not contain any face adjacent fuel assemblies. Restrictions for non-fissile bearing components are described in section 4.3.1.1j below;

Fuel Loading Pattern for Region 1A

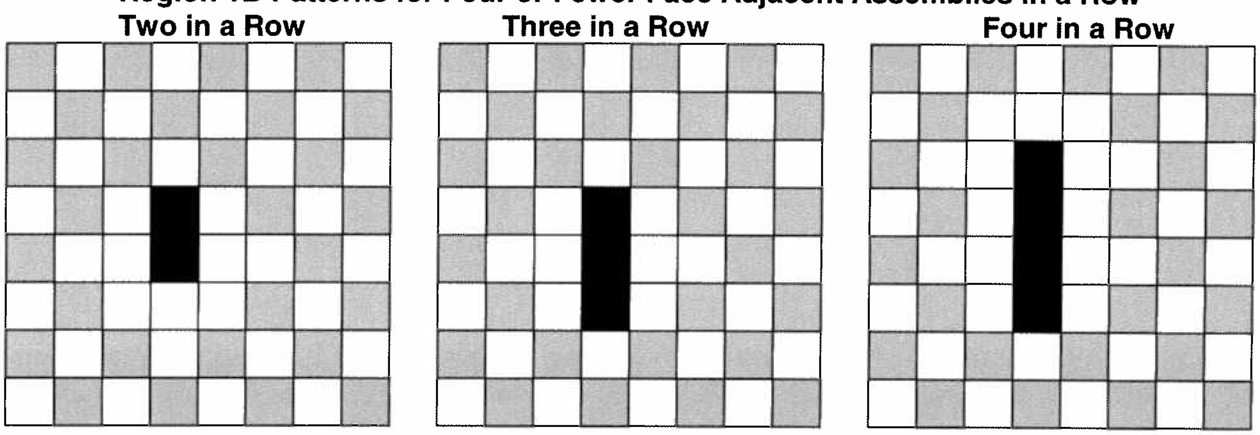


INSERT 1 (continued)

g. Region 1B is defined as the Region I storage racks located in the main spent fuel pool with face adjacent fuel that is surrounded by empty face adjacent cells. Region 1B fuel is limited to those assemblies having a nominal planar average U-235 enrichment of less than or equal to 4.34 weight percent. Region IA cells that are diagonally adjacent to Region 1B may contain fuel assemblies provided conditions of Section 4.3.1.1f, 4.3.1.1g.1 and 4.3.1.1g.2 are met. Restrictions for non-fissile bearing components are described in section 4.3.1.1j below. Additional geometric conditions on Region 1B are:

1. Up to four face adjacent fuel assemblies in a single contiguous row are allowed as shown in the figures below. All other face adjacent cells shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below.

Region 1B Patterns for Four or Fewer Face Adjacent Assemblies in a Row



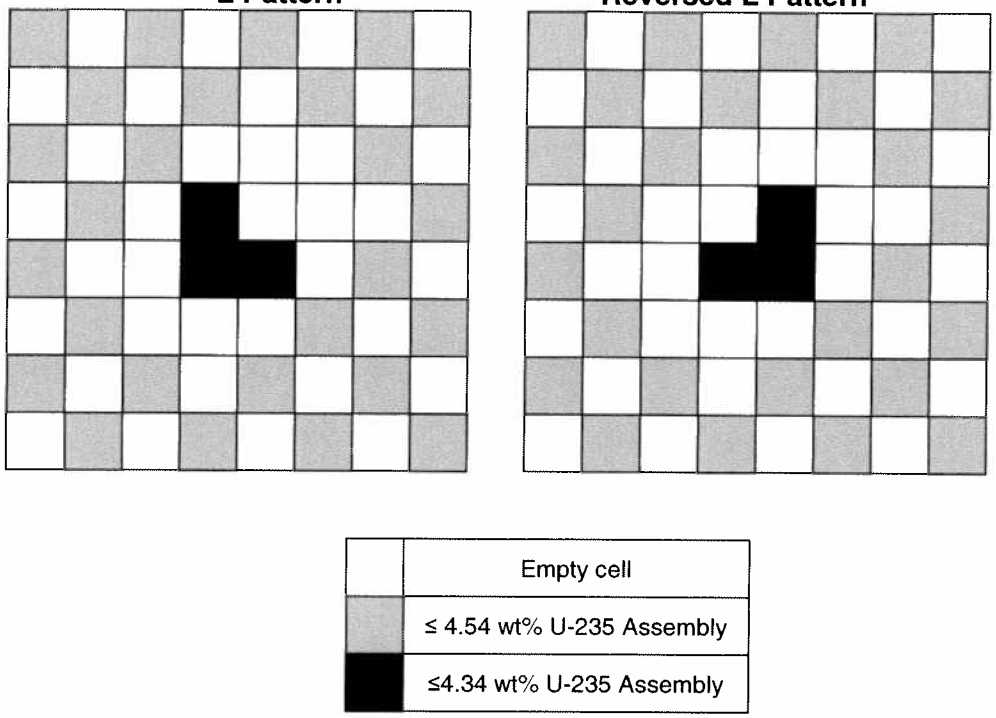
	Empty cell
	≤ 4.54 wt% U-235 Assembly
	≤4.34 wt% U-235 Assembly

INSERT 1 (continued)

2. Three face adjacent fuel assemblies forming an L pattern are allowed as shown in the figures below. All face adjacent cells surrounding the two-by-two block containing the L pattern shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below;

Region 1B Patterns for Three in an L

L Pattern **Reversed L Pattern**



h. Interface Requirements for the Main Spent Fuel Pool

1. Region I fuel racks that have cells that occupy locations F24 through U24 of the Main Spent Fuel Pool are adjacent to fuel racks in Region II of the Main Spent Fuel Pool. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells.

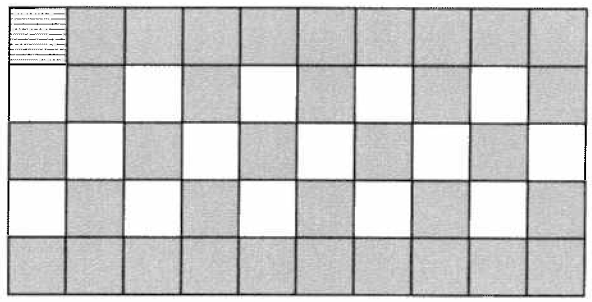
2. There are twelve locations adjacent to the area that contains the elevator and inspection station. These locations are I1, I2, I3, J3, K3, L3, M3, N3, O3, P1, P2, and P3. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells;

INSERT 1 (continued)

i. Region 1E is defined as the Region I storage rack located in the north tilt pit. Region 1E shall maintain the selective loading pattern as shown in the figure below. This selective loading pattern allows for one fuel assembly having a nominal planar average U-235 enrichment of less than or equal to 3.26 weight percent. This assembly shall be placed in the southwest corner location of the rack. All 34 other allowed fuel locations in the figure below are limited to a nominal planar average U-235 enrichment of less than or equal to 3.05 weight percent. The remaining fifteen cells shall be empty; and

Region 1E Allowed Fuel Storage Pattern

North →



	Empty cell
	≤ 3.05 w/o U-235 Assembly
	Location of a single assembly ≤ 3.26 wt% U-235

INSERT 1 (continued)

j. Non-Fissile Bearing Components and restrictions are defined as follows:

1. Non-fissile material component may be stored in any designated fuel location in Region 1A, 1B, or 1E without restriction.

2. The following non-fuel bearing components (NFBC) may be stored face adjacent to fuel in designated empty cells in Region 1A or 1B except for interface locations described above in 4.3.1.1h.

   a. The gauge dummy assembly and the lead dummy assembly may be stored anywhere in Region 1A or 1B.

   b. An assembly comprised of up to 216 solid stainless steel (SS) rods may be stored face adjacent to fuel in a designated empty cell as long as the NFBC is at least ten locations away from another NFBC that is face adjacent to a fuel assembly. Locations within this NFBC assembly not containing SS rod(s) shall be left empty, or

   c. A component comprised primarily of SS that displaces less than 30 square inches of water in any horizontal plane within the active fuel region may be stored face adjacent to fuel, in a designated empty cell, as long as the NFBC is at least ten locations away from another NFBC that is face adjacent to a fuel assembly.

3. Non-fissile bearing components shall not be stored in designated empty cells in Region 1E.