Entergy

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September 1, 2009

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

SUBJECT: License Amendment Request for Spent Fuel Pool Region I Criticality

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

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 criticality requirements for Region I spent fuel pool (SFP) and north tilt pit fuel storage racks, in TS section 4.3.

The criticality analysis supporting the proposed TS change for the Region I fuel storage racks reflects credit for fuel assembly burnup and soluble boron. The proposed change, in accordance with 10 CFR 50.68, Criticality accident requirements, would maintain 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 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 Attachment 1. Attachment 1 also provides a detailed description of the proposed change, a background discussion, a technical analysis, and an environmental review consideration. Attachment 2 provides the revised TS pages reflecting the proposed changes. Attachment 3 provides the annotated TS pages showing the proposed

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changes. Attachment 4 contains AREVA NP Inc. report Document No: ANP-2858-001, "Palisades SFP Region 1 Criticality Evaluation with Burnup Credit."

To support fuel pool operations necessary to accommodate a full reactor core off load during the 2010 refueling outage, ENO requests approval of the proposed license amendment request by September 17, 2010, 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.

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 September 1, 2009.

Sincerely,

cjs/jse

Attachment(s):

1. Description of Requested Changes
2. Revised Technical Specification Pages and Renewed Operating License Page Change Instructions
3. Mark-up of Technical Specification Pages
4. Palisades SFP Region 1 Criticality Evaluation with Burnup Credit

cc: Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

ATTACHMENT 1

DESCRIPTION OF REQUESTED CHANGES

1.0 DESCRIPTION

Entergy Nuclear Operations, Inc. (ENO) requests amending the Renewed Facility Operating License DPR-20 for Palisades Nuclear Plant (PNP) to revise Appendix A, Technical Specifications (TS), fuel storage requirements as they apply to 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 for Region I fuel storage racks. The analysis that supports the proposed changes takes credit for fuel assembly burnup and soluble boron. In accordance with 10 CFR 50.68, Criticality accident requirements, the effective neutron multiplication factor (Keff) limits for Region I storage racks remain the same 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.

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.

2.0 PROPOSED CHANGE

ENO proposes to modify (1) the spent fuel pool storage requirements in TS 3.7.16 by revising a limiting condition for operation (LCO) for Region I fuel and non-fissile bearing component storage and by inserting tables containing spent fuel minimum burnup for Regions 1B, 1C, and 1E and (2) the Region I fuel storage criticality requirements in the TS design features in section 4.3 by describing revised requirements for Regions 1B and 1E and adding requirements for new Region 1C. Requirements in section 4.3 for Region 1A are not changed but are reformatted to align with the format of the proposed requirements for Regions 1B, 1C, and 1E.

The supporting analysis for Region 1B, 1C, and 1E requirements in Attachment 4 has resulted in proposing restrictions on fuel assemblies that are unique and do not allow the use of exact verbiage from NUREG-1432, "Standard Technical Specifications - Combustion Engineering Plants." The content of the specifications adhere to NUREG-1432 to the extent possible.

TS page numbers in TS sections 3 and 4 are also changed due to the revised text.

TS LCO 3.7.16 would be revised to add requirements for the maximum nominal planar average U-235 enrichment and burnup for Region I Region 1B, 1C, and 1E fuel assemblies, and would 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 within the limitations in Specification 4.3.1.1 and, as applicable, within the requirements of the maximum nominal planar average U-235 enrichment and burnup of Tables 3.7.16-2, 3.7.16-3, or 3.7.16-4; and

b. The combination of maximum nominal planar average U-235 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 "3.7.16a." on fuel assembly maximum nominal planar average U-235 enrichment and burnup. The proposed change would clarify Region II LCO "3.7.16b." by replacing an initial enrichment requirement with a requirement on maximum nominal planar average U-235 enrichment. The format differs from NUREG-1432 due to the unique restrictions on fuel assembly storage.

The header in the left hand column in Table 3.7.16-1 would be revised from "Initial Enrichment (Wt%)" to "Nominal Planar Average U-235 Enrichment (Wt%)."

This proposed change is for consistency and clarity.

New Table 3.7.16-2 contains spent fuel minimum burnup requirements for Region 1B, and would read as follows:

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1B of the Spent Fuel Pool

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
2.50	0	1.0
2.60	0.81	1.81
2.80	2.43	3.43
3.00	4.05	5.05
3.20	5.67	6.67
3.40	7.28	8.28
3.60	8.90	9.90
3.80	10.52	11.52
4.00	12.13	13.13
4.20	13.75	14.75
4.40	15.37	16.37
4.54	16.50	17.50

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 2.50 and 4.54 will yield acceptable results.

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

New Table 3.7.16-3 contains spent fuel minimum burnup requirements for Region 1C, and would read as follows:

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1C of the Spent Fuel Pool

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
1.80	0	1.0
2.40	7.07	8.07
2.60	9.43	10.43
2.80	11.78	12.78
3.00	14.15	15.15
3.20	16.50	17.50
3.40	18.98	19.98
3.60	21.45	22.45
3.80	23.93	24.93
4.00	26.40	27.40
4.20	28.84	29.84
4.40	31.28	32.28
4.54	33.00	34.00

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 1.80 and 4.54 will yield acceptable results.

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

New Table 3.7.16-4 contains spent fuel minimum burnup requirements for Region 1E, and would read as follows:

Spent Fuel Minimum Burnup Requirements
for Storage in Region IE of the North Tilt Pit

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
2.50	0	1.0
2.60	0.81	1.81
2.80	2.43	3.43
3.00	4.05	5.05
3.20	5.67	6.67
3.40	7.28	8.28
3.60	8.90	9.90
3.80	10.52	11.52
4.00	12.13	13.13
4.20	13.75	14.75
4.40	15.37	16.37
4.54	16.50	17.50

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 2.50 and 4.54 will yield acceptable results.

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

TS 4.3.1.1 would be revised and read as follows:

"The Region I fuel storage racks (See Figure B 3.7.16-1) incorporating Regions 1A, 1B, 1C 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 would add subsection Region 1C within Region I. The requirements in Region 1A, 1B, 1C and 1E are described below. The proposed changes within TS 4.3.1.1, including those below, would result in revision of the specification that differs from the wording in NUREG-1432.

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

"New or irradiated fuel assemblies having a maximum nominal planar average U-235 enrichment of 4.54 weight percent;"

The proposed change would reflect that the maximum nominal planar average U-235 enrichment for new or irradiated fuel assemblies is now 4.54 weight percent for Region 1B, 1C, and 1E as determined in the analysis in Attachment 4. The maximum nominal planar average U-235 enrichment for Region 1A would be unchanged and would remain as 4.54 weight percent.

TS 4.3.1.1b. would be revised as follows:

Changed the font for "Keff."

TS 4.3.1.1d. would be revised as follows:

"Regions 1A, 1B and 1C have a nominal 10.25 inch center to center distance between fuel assemblies;"

The proposed change would remove the description of the single Type E rack that will be inserted in the revised TS 4.3.1.1e below.

TS 4.3.1.1e. would be revised as follows:

"Region 1E has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies;"

The proposed change removes "new or irradiated assemblies," which is included in the proposed TS 4.3.1.1a, and inserts the description of the Region 1E single Type E rack from TS 4.3.1.1d.

TS 4.3.1.1f. would be revised as follows:

"Region 1A is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1A shall be in a maximum of two-of-four checkerboard loading pattern of two fuel assemblies (or fissile bearing components) and two empty cells. Designated empty cells may contain non-fuel bearing components in accordance with Section 4.3.1.1k.2. below;"

The proposed change would reformat this specification to align with the proposed TS 4.3.1.1g, TS 4.3.1.1h and TS 4.3.1.1i. No changes would be made to fuel assembly storage requirements in this specification.

New TS 4.3.1.1g would be revised as follows:

"Region 1B is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1B shall be in a maximum of three-of-four loading pattern consisting of three fuel assemblies (or fissile bearing components) and one empty cell. Fuel assemblies in Region 1B shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-2. Designated empty cells may contain non-fuel bearing components in accordance with Section 4.3.1.1k.2. below;"

The proposed change reflects the analysis in Attachment 4.

TS 4.3.1.1h would be revised as follows:

"Region 1C is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1C may be in a maximum of four-of-four loading pattern with no required empty cells. Fuel assemblies in Region 1C shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-3;"

The proposed change reflects the analysis in Attachment 4. The existing interface requirements for the main spent fuel pool would be relocated to TS 4.3.1.1i.

TS 4.3.1.1i would be revised as follows:

"i. Interface requirements for the main spent fuel pool between Region 1A, 1B and 1C are as follows. Region 1A, 1B and 1C can be distributed in Region I in any manner provided that any 2-by-2 grouping of storage cells and the assemblies in them correspond to the requirements of 4.3.1.1f, 4.3.1.1g or 4.3.1.1h above;"

Interface requirements would be relocated from TS 4.3.1.1h and revised. Changes to the interface requirements would reflect the analysis in Attachment 4 as related to Regions 1A, 1B, and 1C in the main pool. The existing Region 1E storage requirements would be relocated to TS 4.3.1.1j.

TS 4.3.1.1j. would be revised as follows:

"Region 1E is defined as the Region I storage rack located in the north tilt pit and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1E may be in a maximum of four-of-four loading pattern with no required empty cells. Fuel assemblies in Region 1E shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-4;"

The proposed change would reflect the analysis in Attachment 4. Non-fissile bearing component requirements would be relocated to TS 4.3.1.1k.

TS 4.3.1.1k. would be revised as follows:

"Non-fissile bearing component restrictions are as follows:

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

2. The following non-fuel bearing components (NFBC) may be stored in designated empty cells in Region 1A or 1B.

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

   b. A component comprised primarily of stainless steel that displaces less than 30 square inches of water in any horizontal plane within the active fuel region may be stored in a designated empty cell as long as the NFBC is at least ten locations away from any other NFBC that is in a designated empty cell, with the exception of 4.3.1.1k.2.a. above."

The proposed change would editorially revise TS 4.3.1.1j. for clarity.

The proposed change would remove from TS 4.3.1.1j.2 the exception for interface locations described in TS 4.3.1.1h when storing non-fuel bearing components face adjacent to fuel in designated empty cells in Region 1A or 1B. This exception would be removed due to the analysis in Attachment 4.

The proposed change also would remove TS 4.3.1.1j.2.b. because assemblies comprised of 216 solid stainless steel rods are not installed at Palisades.

Lastly, the proposed change would remove TS 4.3.1.1j.3., which restricted non-fissile bearing components from being stored in designated empty cells in Region 1E. This restriction would be removed because Region 1E would no longer have designated empty cells.

TS 4.3.1.2a. would be revised as follows:

"Fuel assemblies having maximum nominal planar average U-235 enrichment of 4.60 weight percent;"

For consistency with the proposed changes to TS 3.7.16, the proposed change to TS 4.3.1.2a. would insert "nominal" into the specification.

TS 4.3.1.2c. would be revised as follows:

The term "Keff" is reformatted for consistency.

TS 4.3.1.2e. would be revised as follows:

"New or irradiated fuel assemblies which meet the maximum nominal planar average U-235 enrichment, burnup, and decay time requirements of Table 3.7.16-1."

For consistency with the proposed changes to TS 3.7.16, the proposed change to TS 4.3.1.2e. would replace "initial enrichment" with "maximum nominal planar average U-235 enrichment."

TS 4.3.1.3a. would be revised as follows:

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

For consistency with the proposed changes to TS 3.7.16, the proposed change to TS 4.3.1.3a would insert "nominal" into the specification.

TS 4.3.1.2, 4.3.1.3, 4.3.2, 4.3.3 and Figure 4.3-1 would be moved and pages would be repaginated.

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 then spent fuel pool criticality analysis of record. At the time, the neutron absorber, in the Region I SFP and north tilt pit storage racks, was relied on for compliance with TS 4.3.1.1b criticality requirements. TS 4.3.1.1b required 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 was no longer 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 implemented.

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 and ML020440048). 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.

ENO submitted a LAR dated November 25, 2008 (ML083360619 and ML083360624), to restore regulatory compliance with TS 4.3.1.1b and 10 CFR 50.68. This LAR proposed to revise spent fuel pool storage requirements in TS section 3.7.16 and the criticality requirements for the Region I spent fuel pool and north tilt pit storage racks in TS section 4.3.1.1. The supporting criticality analysis credited soluble boron in the same manner and magnitude credited for the Region II fuel storage racks. The NRC subsequently approved the LAR by issuing Amendment No. 236 on February 6, 2009 (ML090160238).

4.0 TECHNICAL ANALYSIS

Region I Criticality Evaluation

AREVA NP Inc. report, Document No. ANP-2858-001, "Palisades SFP Region 1 Criticality Evaluation with Burnup Credit," (Attachment 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 Regions 1B, 1C, and 1E. ENO has reviewed and accepted this report.

Key elements of the report are as follows:

Analysis Conservatisms

- No credit is taken for intermediate spacer grids or end fittings.
- No credit is taken for any boron in the Carborundum® plates.
- The maximum fuel enrichment tolerance of 0.05 weight percent is considered in the tolerance evaluation.
- All fuel box outer steel walls are assumed bowed outward and filled with water (no voiding). For the tolerance calculations, the four-of-four loading configuration bounds the three-of-four loading configuration.

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 CASMO-3 computer code, a multi-group two dimensional transport theory program, was used to generate the fuel assembly isotopic compositions at specified burnups.

Results

The results of the analysis determined that the Region I subregion 1B, 1C, and 1E racks have a Keff of less than 1.0, with the racks loaded with a certain bounding nominal planar average enrichment, 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 a certain bounding nominal planar average enrichment 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 maintained. 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. 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.

Summary of Boron Dilution Evaluation

Consumers Energy (the former owner and license holder) submitted on March 2, 2001, an 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.

<u>Abnormal Conditions and the Double-Contingency Principle</u>
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.

<u>Human Performance</u>
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 requires an independent review by another qualified reactor engineer and ensures that both the preparer and reviewer verify that the fuel move plan will result in approved storage patterns per Technical Specification 4.3.

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 establish additional process controls to minimize the probability of a fuel move error. These notes are discussed during the pre-job brief.

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 lessens the probability of fuel move errors. For each fuel move, these coordinates are verified by the FHC. For Region 1E, which does 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.

Administrative Procedure 4.00, "Operations Organization, Responsibilities and Conduct," provides the controls necessary to conduct fuel handling activities safely and effectively, and ensures adherence with fuel move plans.

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.

The above controls are considered appropriate to minimize the probability of the occurrence of a fuel misload event.

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 TS section 4.3, 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 shown 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 criticality safety analyses for Region I Region 1A and Region II of the spent fuel pool credit 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 does the analysis for the proposed change for Region I Regions 1B, 1C, and 1E.

Crediting soluble boron and burnup in the Region I Region 1B, 1C, and 1E 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 the Region I Region 1A and 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 I Region 1B, 1C, and 1E of the spent fuel pool would remain subcritical by a design margin of at least 0.017 delta K, so the Keff of the fuel in these regions 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-2858-001 , "Palisades SFP Region 1 Criticality Evaluation with Burnup Credit," show, at a 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 the 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 4.54 weight percent in the Region 1A fuel storage rack, 4.34 weight percent in the Region 1B storage rack, and 3.05 weight percent in the 1E Region storage rack with the exception of one assembly in Region 1E having a maximum planar average U-235 enrichment of 3.26 weight percent. The proposed specifications would allow fuel enrichment to 4.54 weight percent in existing Regions 1B and 1E and for new Region 1C would allow fuel enrichment to 4.54 weight percent with minimum enrichment dependent burnup restrictions. The existing Region 1A enrichment of 4.54 weight percent is unchanged in the proposed specifications. 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 procedural controls would remain in place. Changing 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 TS requirements are maintained.

Furthermore, the existing TS contain limitations on the spent fuel pool boron concentration that conservatively bound the required boron concentration of the new criticality analysis. 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 the Region I Region 1A and 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 I Regions 1B, 1C, and 1E of the spent fuel pool would remain subcritical by a design margin of at least 0.017 delta K, so the Keff of the fuel in Region 1 would remain below 1.0 with burnup credit.

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 I Region 1B, 1C, and 1E fuel storage racks in the spent fuel pool, including biases, tolerances and uncertainties, is less than 1.0 with unborated water and is less than or equal to 0.95 with 850 ppm of soluble boron and burnup 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 and burnup 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 under normal, abnormal, or accident conditions.

The current analysis basis for the Region I Region 1A and 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.

<u>Conclusion</u>
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 <u>Applicable Regulatory Requirements/Criteria</u>

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 evaluation in Attachment 4 provides results of analyses for Region I proposed Regions 1B, 1C, and 1E that, with burnup credit, 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, with burnup credit, 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 the 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, specifies 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, standards, regulations and guidance, or pertinent sections thereof, were used in the analyses described in Attachment 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. Entergy Nuclear Operations, Inc. letter to the NRC, dated November 25, 2008, "License Amendment Request for Spent Fuel Pool Region I Criticality" (Accession Nos. ML083360619 and ML083360624)

3. NRC letter issuing Amendment 236 to Palisades Facility Operating License dated February 6, 2009 (Accession No. ML090160238)

ATTACHMENT 2

REVISED TECHNICAL SPECIFICATION PAGES

3.7.16-1 through 3.7.16-5
and
4.0-1 through 4.0-5

AND

RENEWED OPERATING LICENSE PAGE CHANGE INSTRUCTIONS

11 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 lines in the margin indicating the areas of change.

REMOVE	INSERT
Page 3.7.16-1 through 3.7.16-2	Page 3.7.16-1 through 3.7.16-5
Pages 4.0-1 through 4.0-9	Pages 4.0-1 through 4.0-5

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, as applicable, within the requirements of the maximum nominal planar average U-235 enrichment and burnup of Tables 3.7.16-2, 3.7.16-3 or 3.7.16-4; and

b. The combination of maximum nominal planar average U-235 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

Nominal Planar Average U-235 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%.

TABLE 3.7.16-2 (page 1 of 1)

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1B of the Spent Fuel Pool

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
2.50	0	1.0
2.60	0.81	1.81
2.80	2.43	3.43
3.00	4.05	5.05
3.20	5.67	6.67
3.40	7.28	8.28
3.60	8.90	9.90
3.80	10.52	11.52
4.00	12.13	13.13
4.20	13.75	14.75
4.40	15.37	16.37
4.54	16.50	17.50

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 2.50 and 4.54 will yield acceptable results.

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

TABLE 3.7.16-3 (page 1 of 1)

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1C of the Spent Fuel Pool

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
1.80	0	1.0
2.40	7.07	8.07
2.60	9.43	10.43
2.80	11.78	12.78
3.00	14.15	15.15
3.20	16.50	17.50
3.40	18.98	19.98
3.60	21.45	22.45
3.80	23.93	24.93
4.00	26.40	27.40
4.20	28.84	29.84
4.40	31.28	32.28
4.54	33.00	34.00

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 1.80 and 4.54 will yield acceptable results.

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

TABLE 3.7.16-4 (page 1 of 1)

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1E of the North Tilt Pit

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
2.50	0	1.0
2.60	0.81	1.81
2.80	2.43	3.43
3.00	4.05	5.05
3.20	5.67	6.67
3.40	7.28	8.28
3.60	8.90	9.90
3.80	10.52	11.52
4.00	12.13	13.13
4.20	13.75	14.75
4.40	15.37	16.37
4.54	16.50	17.50

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 2.50 and 4.54 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 or M5 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, 1C and 1E are designed and shall be maintained with:

a. New or irradiated fuel assemblies having a maximum nominal planar average U-235 enrichment of 4.54 weight percent;

4.3 Fuel Storage
4.3.1 Criticality (continued)

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. 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. Region 1A, 1B and 1C has a nominal 10.25 inch center to center distance between fuel assemblies;

e. Region 1E has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies;

f. Region 1A is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1A shall be in a maximum of two-of-four checkerboard loading pattern of two fuel assemblies (or fissile bearing components) and two empty cells. Designated empty cells may contain non-fuel bearing components in accordance with Section 4.3.1.1k.2. below;

g. Region 1B is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1B shall be in a maximum of three-of-four loading pattern consisting of three fuel assemblies (or fissile bearing components) and one empty cell. Fuel assemblies in Region 1B shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-2. Designated empty cells may contain non-fuel bearing components in accordance with Section 4.3.1.1k.2. below;

h. Region 1C is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1C may be in a maximum of four-of-four loading pattern with no required empty cells. Fuel assemblies in Region 1C shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-3;

i. Interface requirements for the main spent fuel pool between Region 1A, 1B and 1C are as follows. Region 1A, 1B and 1C can be distributed in Region I in any manner provided that any 2-by-2 grouping of storage cells and the assemblies in them correspond to the requirements of 4.3.1.1f, 4.3.1.1g or 4.3.1.1h above;

4.3 Fuel Storage

4.3.1 Criticality (continued)

j. Region 1E is defined as the Region I storage rack located in the north tilt pit and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1E may be in a maximum of four-of-four loading pattern with no required empty cells. Fuel assemblies in Region 1E shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-4;

k. Non-fissile bearing component restrictions are as follows:

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

2. The following non-fuel bearing components (NFBC) may be stored in designated empty cells in Region 1A or 1B.

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

b. A component comprised primarily of stainless steel that displaces less than 30 square inches of water in any horizontal plane within the active fuel region may be stored in a designated empty cell as long as the NFBC is at least ten locations away from any other NFBC that is in a designated empty cell, with the exception of 4.3.1.1k.2.a. above.

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 nominal 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. Keff ≤ 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

4.3 Fuel Storage

4.3.1 Criticality (continued)

e. New or irradiated fuel assemblies which meet the maximum nominal planar average U-235 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 nominal 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 nominal planar average U-235 enrichment of 4.05 weight percent, and stored in accordance with the pattern shown in Figure 4.3-1;

b. $K_{eff} \leq 0.95$ 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.

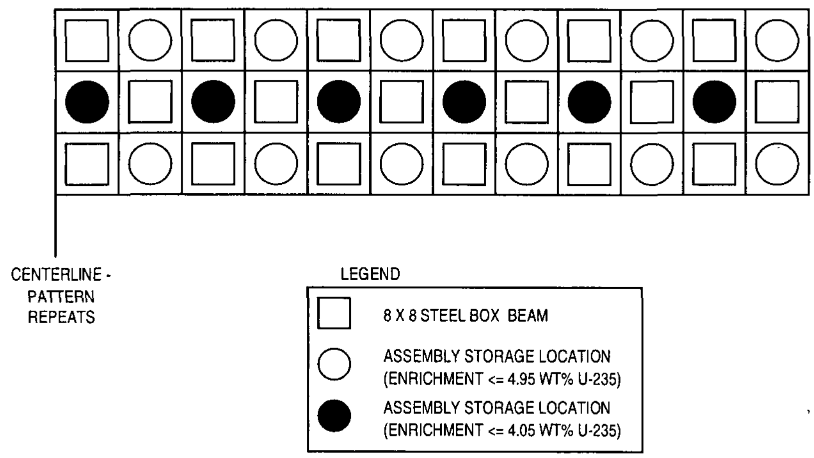
c. The pitch of the new fuel storage rack lattice being ≥ 9.375 inches and every other position in the lattice being permanently occupied by an 8" x 8" structural steel or core plugs, resulting in a nominal 13.26 inch center to center distance between fuel assemblies placed in alternating storage locations.

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.



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

ATTACHMENT 3

MARK-UP OF TECHNICAL SPECIFICATIONS PAGES

(showing proposed changes; additions are highlighted

and deletions are strikethrough)

14 pages follow

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, as applicable, within the requirements of the maximum nominal planar average U-235 enrichment and burnup of Tables 3.7.16-2, 3.7.16-3 or 3.7.16-4; and

b. The combination of maximum nominal planar average U-235 ~~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

Nominal Planar Average U-235 ~~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%.

TABLE 3.7.16-2 (page 1 of 1)

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1B of the Spent Fuel Pool

INSERT NEW TABLE 3.7.16-2

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
2.50	0	1.0
2.60	0.81	1.81
2.80	2.43	3.43
3.00	4.05	5.05
3.20	5.67	6.67
3.40	7.28	8.28
3.60	8.90	9.90
3.80	10.52	11.52
4.00	12.13	13.13
4.20	13.75	14.75
4.40	15.37	16.37
4.54	16.50	17.50

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 2.50 and 4.54 will yield acceptable results.

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

TABLE 3.7.16-3 (page 1 of 1)

Spent Fuel Minimum Burnup Requirements
for Storage in Region 1C of the Spent Fuel Pool

INSERT NEW TABLE 3.7.16-3 →

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
1.80	0	1.0
2.40	7.07	8.07
2.60	9.43	10.43
2.80	11.78	12.78
3.00	14.15	15.15
3.20	16.50	17.50
3.40	18.98	19.98
3.60	21.45	22.45
3.80	23.93	24.93
4.00	26.40	27.40
4.20	28.84	29.84
4.40	31.28	32.28
4.54	33.00	34.00

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 1.80 and 4.54 will yield acceptable results.

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

INSERT NEW TABLE 3.7.16-4

TABLE 3.7.16-4 (page 1 of 1)

Spent Fuel Minimum Burnup Requirements for Storage in Region 1E of the North Tilt Pit

Nominal Planar Average U-235 Enrichment (Wt%)	Burnup (GWD/MTU) (Batches L and later)	Burnup (GWD/MTU) (Batches A through K)
2.50	0	1.0
2.60	0.81	1.81
2.80	2.43	3.43
3.00	4.05	5.05
3.20	5.67	6.67
3.40	7.28	8.28
3.60	8.90	9.90
3.80	10.52	11.52
4.00	12.13	13.13
4.20	13.75	14.75
4.40	15.37	16.37
4.54	16.50	17.50

(a) Linear interpolation between two consecutive points for nominal planar average U-235 enrichments between 2.50 and 4.54 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 or M5 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, 1C, and 1E are designed and shall be maintained with:

a. New or irradiated 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. Keff < 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;

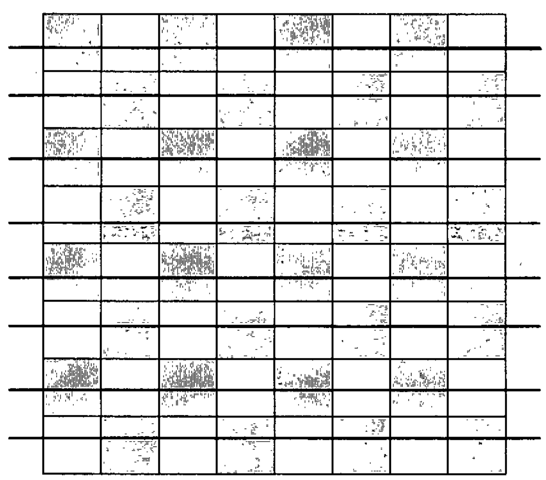
d. Region 1A, 1B, and 1C has a nominal 10.25 inch center to center distance between fuel assemblies ~~with the exception of the single Type E rack which has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies~~;

e. ~~New or irradiated fuel assemblies~~ Region 1E has a nominal 11.25 inch by 10.69 inch center to center distance between fuel assemblies;

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**~~



	~~Empty cell~~
(shaded)	~~≤ 4.54 wt% U-235 Assembly~~

4.3 Fuel Storage

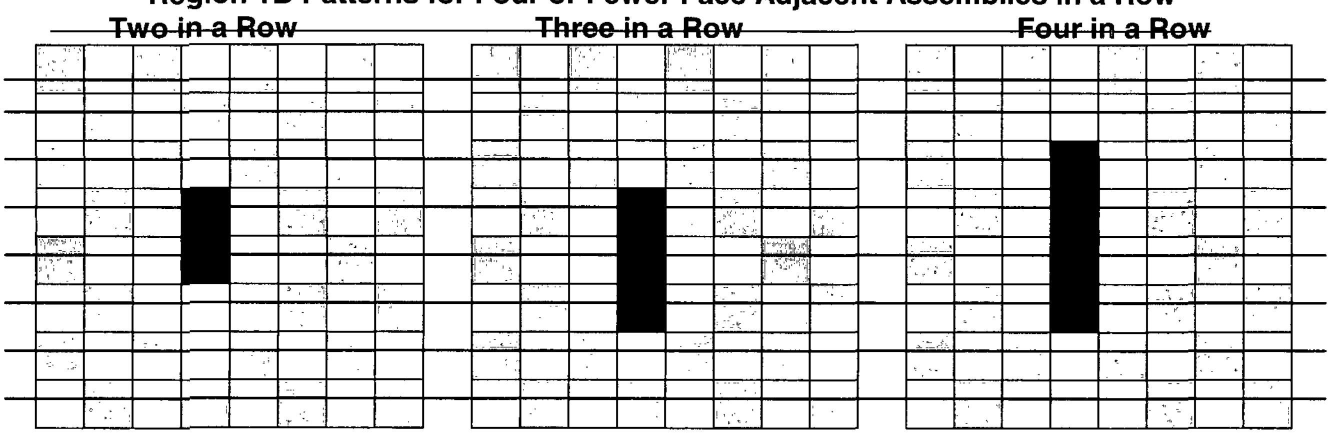
4.3.1 Criticality (continued)

INSERT 2 →

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~~

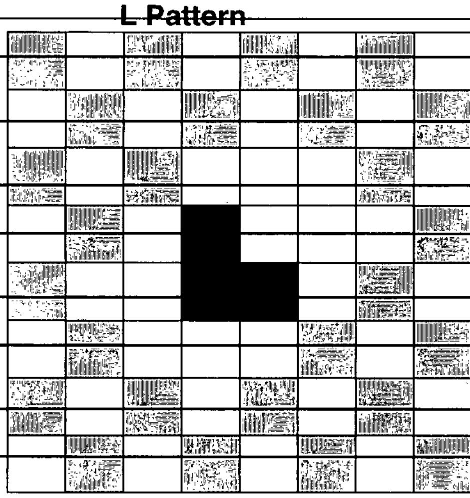
4.3 Fuel Storage

4.3.1 Criticality (continued)

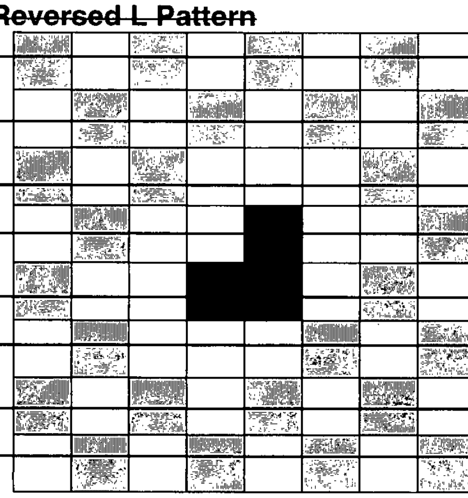
2. Three face adjacent fuel assemblies forming an L pattern are allowed as shown in the figures below. All face adjacent cells surrounding the two-by-two block containing the L pattern shall be empty or contain non-fissile bearing components as described in section 4.3.1.1j below;

Region 1B Patterns for Three in an L

L Pattern



Reversed L Pattern



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

h. Interface Requirements for the Main Spent Fuel Pool

INSERT 3 →

~~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.~~

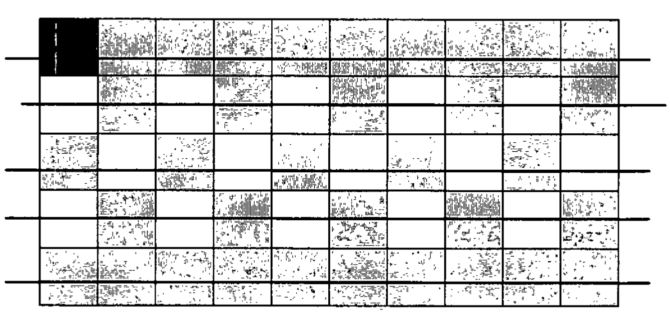
~~2. There are twelve locations adjacent to the area that contains the elevator and inspection station. These locations are I1, I2, I3, J3, K3, L3, M3, N3, O3, P1, P2, and P3. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells;~~

INSERT 4 →

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~~

4.3 Fuel Storage

4.3.1 Criticality (continued)

INSERT 5 →

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.~~

INSERT 6 →

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 nominal 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}~~ Keff ≤ 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~~ maximum nominal planar average U-235 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 nominal 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 nominal 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.

INFORMATION ON PAGES 4.0-8 AND 4.0-9 WILL BE REPAGINATED.

INSERT 1

f. Region 1A is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1A shall be in a maximum of two-of-four checkerboard loading pattern of two fuel assemblies (or fissile bearing components) and two empty cells. Designated empty cells may contain non-fuel bearing components in accordance with Section 4.3.1.1k.2. below;

INSERT 2

g. Region 1B is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1B shall be in a maximum of three-of-four loading pattern consisting of three fuel assemblies (or fissile bearing components) and one empty cell. Fuel assemblies in Region 1B shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-2. Designated empty cells may contain non-fuel bearing components in accordance with Section 4.3.1.1k.2. below;

INSERT 3

h. Region 1C is defined as a subsection of the Region I storage racks located in the main spent fuel pool and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1C may be in a maximum of four-of-four loading pattern with no required empty cells. Fuel assemblies in Region 1C shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-3;

INSERT 4

i. Interface requirements for the main spent fuel pool between Region 1A, 1B and 1C are as follows. Region 1A, 1B and 1C can be distributed in Region I in any manner provided that any 2-by-2 grouping of storage cells and the assemblies in them correspond to the requirements of 4.3.1.1f, 4.3.1.1g or 4.3.1.1h above;

INSERT 5

J. Region 1E is defined as the Region I storage rack located in the north tilt pit and is subject to the following restrictions. Fuel assemblies (or fissile bearing components) located in Region 1E may be in a maximum of four-of-four loading pattern with no required empty cells. Fuel assemblies in Region 1E shall meet the enrichment dependent burnup restrictions listed in Table 3.7.16-4;

INSERT 6

k. Non-fissile bearing component restrictions are as follows:

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

2. The following non-fuel bearing components (NFBC) may be stored in designated empty cells in Region 1A or 1B.

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

   b. A component comprised primarily of stainless steel that displaces less than 30 square inches of water in any horizontal plane within the active fuel region may be stored in a designated empty cell as long as the NFBC is at least ten locations away from any other NFBC that is in a designated empty cell, with the exception of 4.3.1.1k.2.a. above.