UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

February 6, 2009

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

SUBJECT: PALISADES PLANT - ISSUANCE OF AMENDMENT RE: SPENT FUEL POOL REGION I STORAGE REQUIREMENTS (TAC NO. ME0161)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 236 to Renewed Facility Operating License No. DPR-20 for the Palisades Plant. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated November 25, 2008.

The amendment revised Appendix A of the TSs, 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 and north tilt pit fuel storage racks, in TS section 4.3.1.1.

A copy of our related safety evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

Mahesh L. Chawla, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:
1. Amendment No. 236 to DPR-20
2. Safety Evaluation

cc w/encls: Distribution via ListServ

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

ENTERGY NUCLEAR OPERATIONS, INC.

DOCKET NO. 50-255

PALISADES PLANT

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 236
License No. DPR-20

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Entergy Nuclear Operations, Inc. (the licensee), dated November 25, 2008, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public; and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to the license amendment and Paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-20 is hereby amended to read as follows:

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 236, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. Entergy Nuclear Operations shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Lois M. James

Lois M. James, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to the Facility Operating License
and Technical Specifications

Date of Issuance: February 6, 2009

ATTACHMENT TO LICENSE AMENDMENT NO. 236

RENEWED FACILITY OPERATING LICENSE NO. DPR-20

DOCKET NO. 50-255

Replace the following page of the Renewed Facility Operating License No. DPR-20 with the attached revised page. The changed area is identified by a marginal line.

REMOVE	INSERT
Page 3	Page 3

Replace the following pages of the Appendix A Technical Specifications 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 4.0-9	Pages 4.0-1 through 4.0-9

(1) Pursuant to Section 104b of the Act, as amended, and 10 CFR Part 50, "Licensing of Production and Utilization Facilities," (a) ENP to possess and use, and (b) ENO to possess, use and operate, the facility as a utilization facility at the designated location in Van Buren County, Michigan, in accordance with the procedures and limitation set forth in this license;

(2) ENO, pursuant to the Act and 10 CFR Parts 40 and 70, to receive, possess, and use source and special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Updated Final Safety Analysis Report, as supplemented and amended;

(3) ENO, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use byproduct, source, and special nuclear material as sealed sources for reactor startup, reactor instrumentation, radiation monitoring equipment calibration, and fission detectors in amounts as required;

(4) ENO, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material for sample analysis or instrument calibration, or associated with radioactive apparatus or components; and

(5) ENO, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operations of the facility.

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations in 10 CFR Chapter I and is subject to all applicable provisions of the Act; to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) ENO is authorized to operate the facility at steady-state reactor core power levels not in excess of 2565.4 Megawatts thermal (100 percent rated power) in accordance with the conditions specified herein.

(2) The Technical Specifications contained in Appendix A, as revised through Amendment No. 236, and the Environmental Protection Plan contained in Appendix B are hereby incorporated in the license. ENO shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) ENO shall implement and maintain in effect all provisions of the approved fire protection program as described in the Final Safety Analysis Report for the facility and as approved in the SERs dated 09/01/78, 03/19/80, 02/10/81, 05/26/83, 07/12/85, 01/29/86, 12/03/87, and 05/19/89 and subject to the following provisions:

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 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, 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;

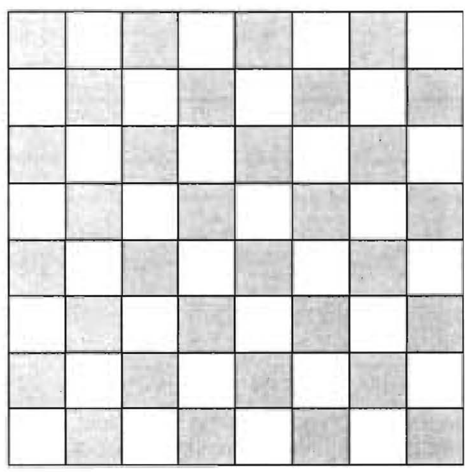
c. Keff ≤ 0.95 if fully flooded with water borated to 850 ppm, which includes allowances for uncertainties as described in Section 9.11 of the FSAR;

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



	Empty cell
	≤ 4.54 wt% U-235 Assembly

4.3 Fuel Storage

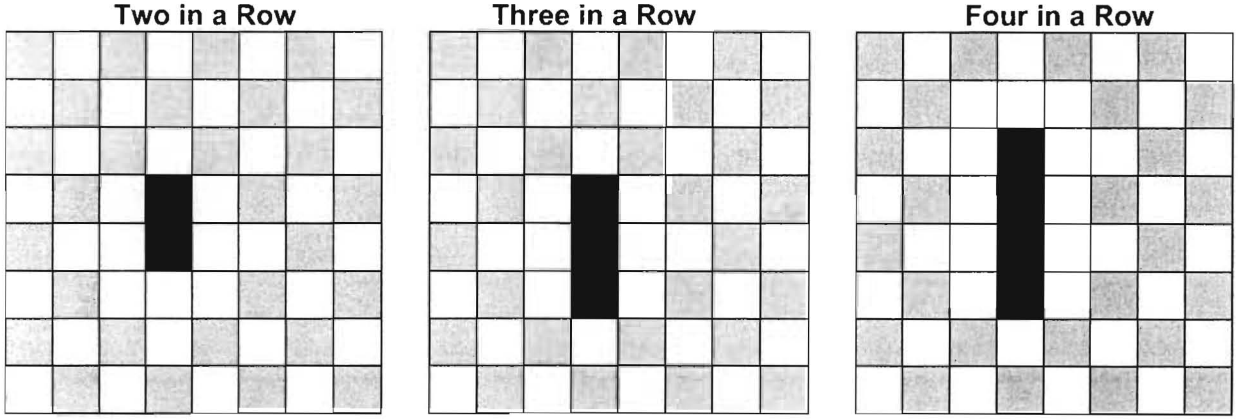
4.3.1 Criticality (continued)

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**



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

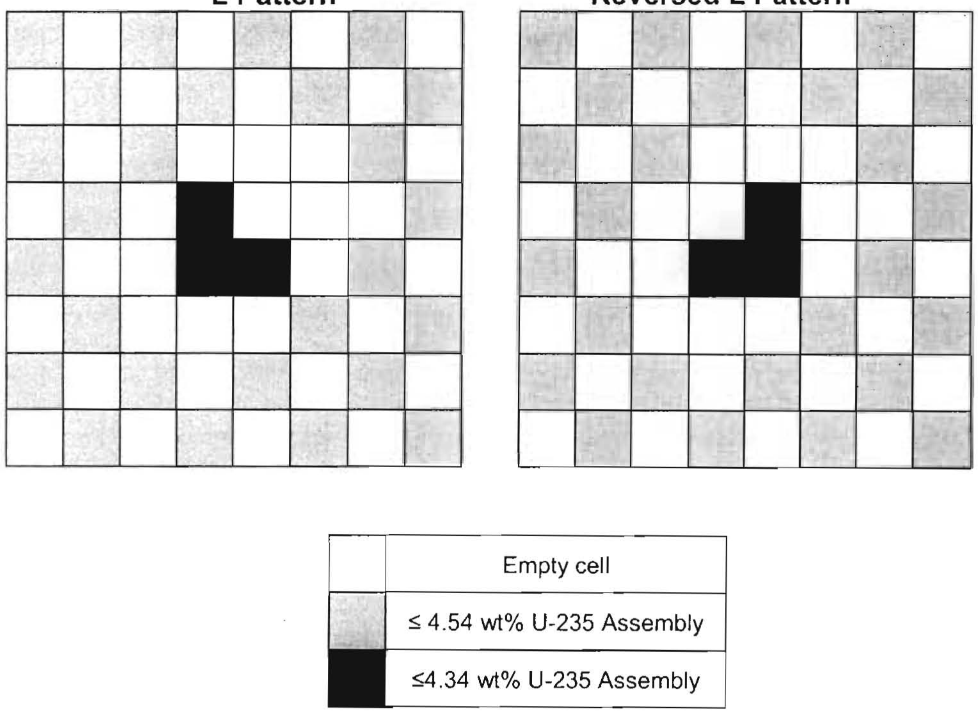
4.3 Fuel Storage

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**



4.3 Fuel Storage
4.3.1 Criticality (continued)

h. Interface Requirements for the Main Spent Fuel Pool

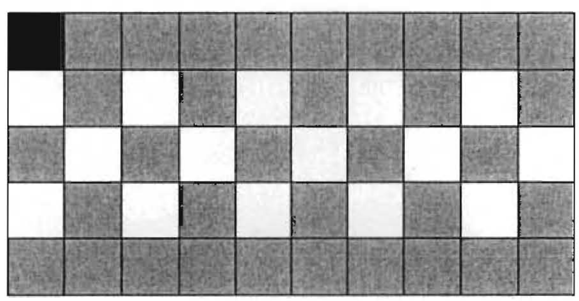
1. Region I fuel racks that have cells that occupy locations F24 through U24 of the Main Spent Fuel Pool are adjacent to fuel racks in Region II of the Main Spent Fuel Pool. These cells shall be loaded with at least one empty cell between each fuel assembly within this group of cells.

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 →



	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)

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)

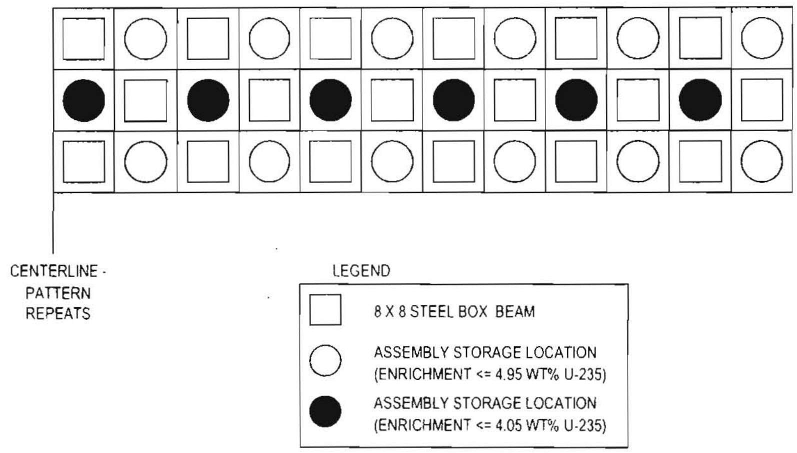
c. The pitch of the new fuel storage rack lattice being ≥ 9.375 inches and every other position in the lattice being permanently occupied by an 8" x 8" structural steel or core plugs, resulting in a nominal 13.26 inch center to center distance between fuel assemblies placed in alternating storage locations.

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.



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

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 236 TO RENEWED

FACILITY OPERATING LICENSE NO. DPR-20

ENTERGY NUCLEAR OPERATIONS, INC.

PALISADES PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

By application dated November 25, 2008, (Reference 1) Entergy Nuclear Operations (the licensee) requested changes to the Technical Specifications (TS) for Palisades Nuclear Plant (PNP) spent fuel pool (SFP) Region I storage requirements. The request is required to accommodate degradation in the installed neutron absorber. As a result of the degradation the Nuclear Regulatory Commission (NRC) issued a Confirmatory Action Letter (Reference 2) to the licensee. Approval of this request is required to remove the restrictions imposed by the Confirmatory Action Letter.

Currently PNP TS allow unrestricted storage of fuel assemblies having a maximum planar average U^{235} enrichment of 4.95 weight percent (w/o) in the SFP Region I. The degradation in the installed neutron absorber no longer supports the current TS. The proposed change does not credit the installed neutron absorber. The proposed change does not credit fuel depletion. The proposed change uses a lower maximum planar average U^{235} enrichment and geometric arrangements to meet the regulatory requirements of Title 10 of the Code of Federal Regulation (10 CFR) 50.68.

Current PNP TS 4.3.1.2 and 3.7.16 allow restricted storage of fuel assemblies having a maximum planar average U^{235} enrichment of 4.60 weight percent in the SFP Region II. Current PNP TS 4.3.1.2.c requires a minimum of 850 parts per million (ppm) of soluble boron in the PNP SFP Region II. As the regions are in the same SFP, Region I will also have a minimum of 850 ppm of soluble boron. There are no changes to the SFP Region II requirements in the licensee's request.

Current PNP TS 3.7.15 requires a minimum of 1720 ppm of soluble boron in the PNP SFP.

The analysis was performed for the licensee by AREVA NP Inc., as ANP-2779NP-001, which is Enclosure 4 (Reference 3) of the licensee's November 25, 2008, request.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal* Regulations (10 CFR) Part 50, Appendix A (Reference 4), Criterion 62 requires, "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations." 10 CFR 50.68(b)(1) requires, "Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water."

Section 50.68(b)(4) of 10 CFR requires, "If no credit for soluble boron is taken, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water. If credit is taken for soluble boron, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water."

Section 50.36(c)(4) of 10 CFR requires, "Design features to be included are those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered in categories described in paragraphs (c) (1), (2), and (3) of this section."

The revised PNP SFP Region I criticality analysis takes credit for soluble boron. Therefore, the regulatory requirement is for the PNP SFP Region I k-effective (k_{eff}) to remain below 1.0, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water and below 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water.

The revised PNP SFP Region I criticality analysis requires specific geometric arrangements of fuel assemblies within the SFP to meet the 10 CFR 50.68(b)(4) regulation. Therefore, there is a regulatory requirement for those geometric arrangements to be captured in the Design Features section of the TS.

3.0 PROPOSED CHANGE

Currently PNP TS allow unrestricted storage of fuel assemblies having a maximum planar average U^{235} enrichment of 4.95 w/o in the SFP Region I. The degradation in the installed neutron absorber no longer supports the current TS. Additionally, due to swelling in the walls of storage cells, several fuel assemblies can not be withdrawn and other storage cells will not accept a fuel assembly. The proposed change does not credit the installed neutron absorber while accommodating the effects of the swollen cell walls. The proposed change does not credit fuel depletion. The proposed change uses a nominal planar average U^{235} enrichment of 4.54 w/o and geometric arrangements to meet the regulatory requirements of 10 CFR 50.68. The proposed change divides the PNP SFP Region I into three sub-regions: IA, IB, and IE. The geometric arrangement of Region IA is a checkerboard pattern and may contain fresh fuel up to a nominal planar average U^{235} enrichment of 4.54 w/o. Region IB is actually five different storage configurations that may be found within areas that otherwise would be used as Region IA, but need to accommodate face-to-face adjacent fuel assemblies that can not be withdrawn.

The Region IB face-to-face adjacent fuel assemblies must meet the lower nominal planar average U^{235} enrichment of 4.34 w/o, with no face-to-face adjacent fuel assemblies at a higher nominal planar average U^{235} enrichment. Region IE is a physically separate area of the SFP. The Region IE storage configuration is specific to that area. The maximum nominal planar average U^{235} enrichment allowed in Region IE is 3.05 w/o, except for one fuel assembly which has a nominal planar average U^{235} enrichment of 3.26 w/o.

As stated above, the regulatory requirement is for the PNP SFP Region I k_{eff} to remain below 1.0, at a 95 percent probability, 95 percent confidence level, if flooded with unborated water and below 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water. The licensee's submittal indicates that, within the bounds of the analysis, the revised PNP SFP Region I k_{eff} if flooded with unborated water under nominal conditions will be less than 0.9758, and, if flooded with 850 ppm soluble boron under nominal conditions will be less than 0.8927, and if flooded with 1350 ppm soluble boron under abnormal conditions will be less than 0.9427. Thus the licensee's analysis indicates ample margin to the regulatory requirements in the three conditions.

4.0 TECHNICAL EVALUATION

4.1 Methodology

There is no generic methodology for performing SFP criticality analyses. The staff issued an internal memorandum on August 19, 1998, containing guidance for performing the review of SFP criticality analysis (Reference 5). This memorandum is known colloquially as the "Kopp Letter," after the author. While the Kopp Letter does not specify a methodology it does provide some guidance on more salient aspects of a criticality analysis. The guidance is germane to boiling water reactors and pressurized water reactor, borated and unborated. The Kopp Letter has been used as a touchstone for virtually every pressurized water reactor SFP criticality analysis since, including this PNP analysis.

4.2 Computer Code Validation

ANP-2779NP-001 used the KENO V.a module and CSAS25 driver in the SCALE 4.4a code package with the 44 energy group cross-section library 44GROUPNDF5 for the spent fuel criticality analysis. The code validation is presented in Appendix A of ANP-2779NP-001. The licensee's code validation used NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Methodology," (Reference 6) as guidance.

The code validation considered 100 experiments from seven sources. The code validation determined a "methodology" bias and uncertainty in a manner consistent with NUREG/CR-6698, including consideration of the uncertainty associated with experimental results.

The code validation's statistical treatment of the data was performed in a manner consistent with NUREG/CR-6698, including identification of trends and tests for normalcy of the distribution of results.

The code validation included documentation of the Area of Applicability of the experiments with respect to the modeled environment, the PNP SFP Region I storage racks. As all fuel in the analysis is modeled as fresh fuel the lack of fission product isotopes in the experiments did not affect the validation results.

In keeping with the overall margin to the regulatory requirements identified above, the staff believes the code validation performed in support of the licensee's license amendment request (LAR) is acceptable.

4.3 Spent Fuel Pool

4.3.1 Description of the Spent Fuel Pool

The PNP SFP is currently divided into two Regions. Region I storage racks are a flux trap design with a permanently installed neutron absorber in the form of Carborundum® plates. There are actually two types of Region I storage racks. Type C cells are in the main portion of the SFP while Type E cells are in the North Tilt Pit area of the SFP. The storage cell spacing on the Type E racks is larger than the Type C racks, and is not symmetric. Region II storage racks are a high density design that contain a permanently installed neutron absorbers in the form of Boraflex. However, due to Boraflex degradation, credit is not taken for any Boraflex that is left in the storage racks. And, fuel storage in Region II is restricted based on a previously established burnup/enrichment table. It is the unanticipated degradation of the Carborundum® plates that is the impetuous for this LAR. Additional details describing the PNP SFP are included in the licensee's LAR.

The Carborundum® plates installed at Palisades are composed of B_4C with a phenol filler material. Palisades conducted neutron attenuation testing of several Carborundum® plates in the summer of 2008 and that testing is what revealed the material degradation. However, the analysis of that testing is not complete and the full scope of the degradation is unknown. Therefore the Boron in the B_4C is not modeled, leaving just the Carbon.

To evaluate the swelling the analysis considers two scenarios. One model is with no swelling. The other is with the cell walls swollen inward to the point where they would contact the fuel assembly and swollen outward to the point where the cell walls meet. The cell wall internal volume created by the swelling is modeled as being a void, as it is uncertain as to the actual cause of the swelling and whether or not SFP water is filling the volume created by the swelling. The analysis takes the more reactive of the two scenarios as the limiting case.

4.3.2 Spent Fuel Pool Mechanical Uncertainties

The material and configuration of the SFP racks contributes to the reactivity; the material by providing a fixed neutron absorber and the configuration by controlling the fuel assembly spacing. The staff has provided guidance on how these uncertainties should be treated (Reference 5).

A Region I storage cell in the PNP SFP is two concentric stainless steel boxes which sandwich a Carborundum® plate on each cell wall. The storage cells in Type C racks have a stainless steel support rod in each corner. The storage cells in Type E racks have two stainless steel support rods in each corner. The application documents a sensitivity study in Appendix B to ANP-2779NP-001 on the following SFP mechanical tolerances: storage cell inner dimension, storage cell outer dimension, inner wall thickness, outer wall thickness, and cell pitch. Positive reactivity effects were included in the combination of uncertainties is the body of ANP-2779NP-001. The sensitivity study was performed separately for the Type C and Type E racks, for both 2-out-of-4 and of 3-out-of-4 storage configurations in each type, and with each type both with and without swollen cell walls. The analysis does not consider uncertainties for the Carborundum® plates, modeled as carbon, or the stainless steel support rods. Therefore, potentially not all of the positive reactivity effects have been identified. The subsequent discussion on the combination of biases and uncertainties determines the acceptability of this practice.

4.3.3 Spent Fuel Pool Temperature Bias

NRC guidance provided in the Kopp Letter states the criticality analysis should be done at the temperature corresponding to the highest reactivity. If the SFP has a positive moderator temperature coefficient, the temperature corresponding to the highest reactivity would be the highest allowed operating temperature. ANP-2779NP-001 performed the bulk of the analyses at a base of 273K with a water density of 1.0 gm/cc.

The application documents a sensitivity study in Appendix B to ANP-2779NP-001 on SFP moderator temperature. The sensitivity study was performed separately for the Type C and Type E racks, for both 2-out-of-4 and of 3-out-of-4 storage configurations in each rack type, and with each rack type both with and without swollen cell walls. The temperature was varied from 32°F to 200°F. A negative reactivity effect was shown for all combinations modeled. A slightly higher reactivity was shown for the 32°F case as compared to the 273K case which cited a water density of 1.0 gm/cc. This was due to the following reasons. The maximum density of water actually occurs at about 39°F. So the density at 32°F would be slightly less than 1.0 gm/cc. This would also be true for water at 273K, which is equal to 32°F. However, for the case at 273K the analyst selected the water density, through code input, to be 1.0 gm/cc. This slight difference was then appropriately reconciled by adding the difference as a bias in the combination of biases and uncertainties in the body of ANP-2779NP-001 and was found to be acceptable.

4.4 <u>Fuel Assembly</u>

4.4.1 Selection of Bounding Fuel Assembly Design

The application documents a sensitivity study in Appendix B to ANP-2779NP-001 on the fuel assembly enrichment zoning and orientation in the SFP. The enrichment loading in the fuel assemblies at PNP is asymmetric. Palisades has a wide and narrow water gap between each assembly and the lower enrichments are loaded in the core next to the wide water gaps. In the SFP, the assemblies can be placed in any orientation. The sensitivity study also included eccentric positioning of the fuel assemblies in the storage cell. Since the swelling model used in the analysis would not allow eccentric positioning, the sensitivity study only considered the un-swollen model.

The sensitivity study provides some indication that using a planar average enrichment to model the explicit enrichment zoning in actual fuel assemblies is conservative. The analysis is specific to PNP Batch X1 fuel assembly. Given the reserved analytical margin in ANP-2779NP-001 the comparison is reasonable for this specific analysis.

The eccentric positioning cases move the fuel assemblies within a 2x2 model of storage cells. The boundary conditions make this model an infinitely repeating 2x2 array of storage cells. Within this modeling practice every movement of a fuel assembly is counter balanced by opposing movement in an adjacent 2x2 array, a conservation of spacing occurs. This conservation of spacing may result in a less reactive state than if the fuel assemblies in the storage cells surrounding the modeled 2x2 array are maintained in the nominal position. The sensitivity study considered several eccentric loading positions and used the most positive reactivity effect in the combination of uncertainties in the body of ANP-2779NP-001. Given the conservatism in the manner in which the combination of biases and uncertainties is used in ANP-2779NP-001, this treatment is reasonable for this specific analysis.

The licensee's analysis assumes not modeling the spacer grids or mixing grids is conservative, and therefore the differences in number, size, and composition of the grids is immaterial. The spacer grids or mixing grids will have a non-zero absorption cross-section. Recent submittals by other licensees have provided indication that not modeling the spacer grids is not always conservative, especially in the presence of soluble boron. See comments in the Borated Criticality Analysis section below.

4.4.2 Fuel Assembly Mechanical Tolerances

The application documents a sensitivity study in Appendix B to ANP-2779NP-001 on the following fuel assembly mechanical tolerances: enrichment, theoretical density, pellet diameter, cladding internal diameter, cladding outer diameter, instrument tube internal diameter, and instrument tube. Positive reactivity effects were included in the combination of uncertainties in the body of ANP-2779NP-001. Where a positive effect was shown for both the maximum and minimum perturbations for a parameter, the largest effect was included. The sensitivity study was performed separately for the Type C and Type E racks, for both 2-out-of-4 and of 3-out-of-4 storage configurations in each type, and with each type both with and without swollen cell walls. The analysis does not consider uncertainties for the fuel rod pitch or the guide bars. Therefore, potentially not all of the positive reactivity effects have been identified. The subsequent discussion on the combination of biases and uncertainties determines the acceptability of this practice.

4.5 Spent Fuel Characterization

For this PNP SFP criticality analysis all fuel is modeled as fresh un-irradiated fuel.

4.6 Unborated Criticality Analysis

Independent uncertainties are statistically combined with a root means sum of the squares method. Therefore, the effect of an individual uncertainty is somewhat muted, especially for small effects. The uncertainty resultant is summed with appropriate biases. This summation is the combination of biases and uncertainties. It is in the combination of biases and uncertainties that the analysis achieves the 95 percent probability, 95 percent confidence level. One aspect of the analysis maybe balanced against another to provide reasonable assurance that the 95 percent probability, 95 percent confidence level has been obtained.

ANP-2779NP-001 performs a combination of biases and uncertainties for both Type C and Type E racks, each with a 2-out-of-4 and of 3-out-of-4 storage configuration, and each of those both with and without swollen cell walls. The largest combination of biases and uncertainties occurred in the Type E racks with the 3-out-of-4 storage configurations without swollen cell walls. The analysis takes that value, 0.0286 Δk_{eff}, increases it by 0.0014 Δk_{eff} and then uses 0.0300 Δk_{eff} as the combination of biases and uncertainties for all subsequent cases. This provides a measure of conservatism to compensate for the possibility that not all positive uncertainties were determined.

Whereas the combination of biases and uncertainties are determined with a 2x2 model, the criticality cases are performed with an 8x8 model for Region IA and IB and explicit model of Region IE. The limiting keff of 0.9758, with 0.0300 Δk_{eff} as the combination of biases and uncertainties, occurs in the Region IB 3-in-an-L with swollen cell walls. The Region IB 3-in-an-L is reasonably similar to the Type C with the 3-out-of-4 storage configuration. The combination of biases and uncertainties for the Type C with the 3-out-of-4 storage configurations and with swollen cell walls was 0.0172 Δk_{eff}. Therefore using 0.0300 Δk_{eff} as the combination of biases and uncertainties provides additional analytical margin to the regulatory limit to accommodate the nuances in determining the combination of biases and uncertainties.

The maximum Region IE criticality case included swollen cell walls and generated a k_{eff} of 0.9622, with 0.0300 Δk_{eff} as the combination of biases and uncertainties. Using the combination of biases and uncertainties generated for the Type E racks with the 2-out-of-4 and 3-out-of-4 storage configurations for the entire Region IE is a bit of an approximation. The maximum Type E swollen wall combination of biases and uncertainties occurs in the 3-out-of-4 storage configurations was 0.0226 Δk_{eff}. Therefore using 0.0300 Δk_{eff} as the combination of biases and uncertainties provides additional analytical margin to the regulatory limit to accommodate the nuances in determining the combination of biases and uncertainties.

4.7 Borated Criticality Analysis

The regulatory requirement for soluble boron credit is that the k_{eff} of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water. This includes both nominal and abnormal/accident conditions.

The nominal condition soluble boron crediting methodology in ANP-2779NP-001 is to take the same Region IA, IB and IE models used in the unborated analysis and model them with 850 ppm of soluble boron. The limiting k_{eff} of 0.8927, with 0.0300 Δk_{eff} as the combination of biases and uncertainties, occurs in the Region IB 3-in-an-L with swollen cell walls. The same combination of biases and uncertainties that was determined in the unborated portion of the analysis is used here as well. Using biases and uncertainties determined without soluble boron in cases that include soluble boron is a bit of an approximation. In this case using 0.0300 Δk_{eff} as the combination of biases and uncertainties and the analytical margin to the regulatory limit provides an appreciable amount of conservatism to accommodate the nuances in determining the combination of biases and uncertainties.

The abnormal/accident condition soluble boron crediting methodology in ANP-2779NP-001 is to take the same Region IA, IB and IE models used in the unborated analysis and model them with 1350 ppm of soluble boron in various abnormal/accident conditions. The limiting k_{eff} of 0.9422, with 0.0300 Δk_{eff} as the combination of biases and uncertainties, occurs in the Region IB 4-in-an-Row with swollen cell walls and misloaded fuel assembly on the end with nominally loaded diagonally adjacent storage cells. The same combination of biases and uncertainties that was determined in the unborated portion of the analysis is used here as well. Using biases and uncertainties determined without soluble boron and in nominal configurations in cases that include soluble boron in accident configurations is a bit of an approximation. As with the other situations using 0.0300 Δk_{eff} as the combination of biases and uncertainties, the PNP TS requiring 1720 ppm of soluble boron and the analytical margin to the regulatory limit provide an appreciable amount of conservatism to accommodate the nuances in determining the combination of biases and uncertainties.

As mentioned earlier, the licensee's analysis does not model the spacer grids and this assumption may be non-conservative when crediting soluble boron. However, the NRC staff considers there to be sufficient reserved analytical margin in the soluble boron crediting portion of the analysis to accommodate the potential non-conservatism in the borated scenarios when not modeling the grids.

4.8 Non-Fuel Bearing Components

The analysis considers four separate types of Non-Fuel Bearing Components (NFBC). They are evaluated in the Type C racks with the 2-out-of-4 storage configuration with and without swollen cell walls. The NFBC are placed in the empty cells of the 2-out-of-4 storage configuration. The NFBCs were determined to increase reactivity by 0.0018 Δk_{eff} for the swollen wall model and by 0.0010 Δk_{eff} for the un-swollen wall model. These values are treated as biases in the combination of biases and uncertainties. In accordance with the proposed TS change, NFBC may be stored in any Region I location in lieu of a fuel assembly. In accordance with the proposed TS change, NFBC may be stored, with restrictions, in Region IA and IB locations otherwise required to be empty. In accordance with the proposed TS change, NFBC may not be stored in any Region IE location otherwise required to be empty. The effect of a NFBC in Region IB storage configurations is not explicitly analyzed. Rather the difference between the 0.0300 Δk_{eff} used as the combination of biases and uncertainties and the combination of biases and uncertainties for the Type C racks in the 3-out-of-4 storage configuration with swollen cell walls is cited as justification for placing a NFBC in Region IB empty locations. That difference is 0.0074 Δk_{eff}. Since that difference is much larger than the maximum increase found in the analysis of 2-out-of-4 storage configuration the various storage configurations of Region IB were not determined. While the Region IB 3-in-an-L, or 3-in-a-Reversed-L, is reasonably similar to the Type C with the 3-out-of-4 storage configuration, when that empty location is filled with a NFBC it is a bit of an approximation. The other the Region IB storage configurations are not similar to either a 2-out-of-4 or 3-out-of-4 storage configuration, so using the combination of biases and uncertainties associated with those storage configurations stretches the approximation a bit further. While there is some engineering judgment in the justification for placing NFBC in empty Region IB locations, the NRC staff concurs that the conservatism represented by using 0.0300 Δk_{eff} as the combination of biases and uncertainties and the analytical margin to the regulatory limit provide sufficient conservatism to allow a reasonable assurance conclusion regarding the storage of NFBC is Region IB empty locations.

4.9 Region I/Region II Interface

The analysis created specific interface models for Region II and Region I Type C and Type E racks. The analysis shows that the interaction between the regions is very small and does not result in an appreciable increase in reactivity. Separate biases and uncertainties were not determined for this part of the analysis. While explicit biases and uncertainties may change which Region is limiting with respect to another in the models, it is unlikely they would result in a challenge to the regulatory requirements.

5.0 SUMMARY

Since the licensee takes credit for soluble boron during accident scenarios the regulatory requirement is taken from 10 CFR 50.68(b)(4) which requires, "If credit is taken for soluble boron, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k_{eff} must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water." The licensee determined a maximum k_{eff} of 0.9758 for the unborated nominal condition, a maximum k_{eff} of 0.8927 for the unborated nominal condition, and a maximum k_{eff} of 0.9422 for the unborated abnormal/accident conditions. The analytical margin these values represent, coupled with the conservative combination of biases and uncertainties, allows the staff to reach a reasonable assurance conclusion that the proposed LAR will meet the requirements of 10 CFR 50.68.

6.0 FINAL NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

The Commission may issue the license amendment before the expiration of the 60-day period provided that its final determination is that the amendment involves no significant hazards consideration. This amendment is being issued prior to the expiration of the 60-day period. Therefore, a final finding of no significant hazards consideration follows.

The Commission has made a final determination that the amendment request involves no significant hazards consideration. Under the Commission's regulations in 10 CFR 50.92, this means that operation of the facility in accordance with the proposed amendment does not (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. As required by 10 CFR 50.91(a), the licensee provided its analysis of the issue of no significant hazards consideration which was published in an individual notice published in *Federal Register* (74 FR 123) on January 2, 2009.

The NRC staff has reviewed the licensee's analysis and based on this review, determined that the three standards of 10 CFR 50.92 are satisfied. Therefore, the NRC staff has determined that the amendment involves no significant hazards consideration.

7.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Michigan State official was notified of the proposed issuance of the amendment. The Michigan State official had no comments.

8.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 or change the surveillance requirements. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding (74 FR 123). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

9.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

10.0 REFERENCES

1. Entergy Nuclear Operations letter from Christopher J. Schwarz, Site Vice President, Palisades Nuclear Plant, to U.S. NRC document control desk, regarding "Palisades Nuclear Plant Docket No. 50-255, License No. DPR-20, License Amendment Request for Spent Fuel Pool Region I Criticality," November 25, 2008. (Agencywide Documents Access and Management System (ADAMS) Accession No. ML083360619)

2. U.S. NRC letter to Christopher J. Schwarz, Site Vice President, Palisades Nuclear Plant, "Confirmatory Action Letter – Palisades Nuclear Plant Commitments to Address Degraded Spent Fuel Pool Storage Rack Neutron Absorber," dated September 18, 2008. (ADAMS Accession No. ML082630145)

3. AREVA NP Inc. report, Document No. ANP-2779NP-001, "Palisades SFP Region 1 Criticality Evaluation." (ADAMS Accession No. ML083360624)

4. 10 CFR Part 50 Appendix A, "General Design Criteria for Nuclear Power Plants"

5. NRC Memorandum from L. Kopp to T. Collins, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants," August 19, 1998. (ADAMS Accession No. ML003728001)

6. NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Calculation Methodology"

Principal Contributor: Kent Wood, NRR

Date: February 6, 2009

February 6, 2009

Vice President, Operations
Entergy Nuclear Operations
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES PLANT - ISSUANCE OF AMENDMENT RE: SPENT FUEL POOL REGION I STORAGE REQUIREMENTS (TAC NO. ME0161)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 236 to Renewed Facility Operating License No. DPR-20 for the Palisades Plant. The amendment consists of changes to the Technical Specifications (TSs) in response to your application dated November 25, 2008.

The amendment revised Appendix A of the TSs, 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 and north tilt pit fuel storage racks, in TS Section 4.3.1.1.

A copy of our related safety evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,
/RA/
Mahesh L. Chawla, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:
1. Amendment No. 236 to DPR-20
2. Safety Evaluation

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ADAMS Accession No. ML090160238 * Memo dated January 9, 2008

OFFICE	LPL3-1/PM	LPL3-1/LA	SRXB/BC	ITSB/BC	OGC	LPL3-1/BC
NAME	MChawla	BTully	GCranston*	RElliott	BHarris	LJames
DATE	2/03/09	2/03/09	01/09/09	1/29/09	2/04/09	2/06/09

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