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Palisades Nuclear Plant
Operated by Nuclear Management Company, LLC

September 14, 2001

U.S. Nuclear Regulatory Commission
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DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT
PALISADES PLANT – ENVIRONMENTAL ASSESSMENT REGARDING TECHNICAL SPECIFICATION CHANGE REQUEST FOR SPENT FUEL POOL BORON CONCENTRATION

On March 2, 2001, Consumers Energy Company submitted a request for NRC approval of changes to the Palisades Plant Technical Specifications to increase the limits on stored fuel enrichment, impose a minimum spent fuel pool boron concentration requirement whenever fuel is stored in the spent fuel pool, and require that the spent fuel pool boron concentration be verified weekly. The enclosure to this letter provides an environmental assessment of the changes proposed in the March letter.

SUMMARY OF COMMITMENTS

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

Paul A. Harden
Director, Engineering

CC Administrator, Region III, USNRC
Project Manager, NRR, USNRC
NRC Resident Inspector – Palisades

Enclosure

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NUCLEAR MANAGMENT COMPANY, LLC
PALISADES NUCLEAR PLANT
DOCKET 50-255

ENVIRONMENTAL ASSESSMENT REGARDING TECHNICAL SPECIFICATION CHANGE REQUEST FOR SPENT FUEL POOL BORON CONCENTRATION

To the best of my knowledge, the content of this letter providing the Palisades Plant environmental assessment for the previously submitted request to change plant Technical Specifications regarding spent fuel pool boron and fuel storage limitations, is truthful and complete.

By _____
Paul A. Harden
Director, Engineering

Sworn and subscribed to before me this 14th day of September, 2001

_____
Janice M. Milan, Notary Public
Allegan County, Michigan
(Acting in Van Buren County, Michigan)
My commission expires September 6, 2003

(Seal)

ENCLOSURE

NUCLEAR MANAGEMENT COMPANY, LLC
PALISADES PLANT
DOCKET 50-255

SEPTEMBER 14, 2001

ENVIRONMENTAL ASSESSMENT REGARDING TECHNICAL SPECIFICATION CHANGE REQUEST FOR SPENT FUEL POOL BORON CONCENTRATION

8 Pages

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IDENTIFICATION OF PROPOSED ACTION

The proposed Technical Specification changes would:

A. Allow storage of un-irradiated fuel up to 4.95 wt% enrichment in the new fuel storage racks assuming defined loading patterns.

B. Allow storage of un-irradiated or irradiated fuel up to 4.95 wt% enrichment in Region I fuel storage racks with no credit for soluble boron in the pool under normal conditions, and credit for 1350 ppm of soluble boron under accident conditions.

C. Allow storage of un-irradiated fuel up to 1.14 wt% enrichment and irradiated fuel of equivalent reactivity up to 4.6 wt% initial enrichment in Region II fuel storage racks with credit for 850 ppm of soluble boron in the pool under normal conditions, and credit for 1350 ppm of soluble boron under accident conditions. Assembly burnup and subsequent decay time are also considered in the criticality calculations. The Region II fuel storage rack criticality analysis conservatively ignores the Boraflex poison material present in the racks.

THE NEED FOR THE PROPOSED ACTION

The need for the identified changes to the Palisades Technical Specifications is categorized into two separate areas:

1) Changes to the fuel enrichment and burnup combinations acceptable for storage in Region II racks are needed to allow flexibility in fuel placement within the pool. Specifically, recent fuel assembly enrichments have been above the current 3.27 wt% enrichment limit for Region II defined in Technical Specification 4.3.1.2. These assemblies can currently only be stored in Region I racks. In addition, the criticality calculations which are the basis for these proposed changes do not credit the Boraflex poison material in the Region II racks. Since the Boraflex will no longer be relied upon for reactivity control, programs designed to ensure the integrity of the poison (e.g. periodic Blackness testing) will be discontinued.

2) The proposed action to increase fuel storage enrichment limits allows Nuclear Management Company flexibility to pursue increased reload fuel enrichments in order to optimize fuel cycle costs. It is important to note that the proposed action would change the fuel enrichment that is acceptable for storage in the new and spent fuel racks only. Palisades Technical Specifications do not limit core reload fuel enrichment or assembly burnup. However, evaluations of reload core designs (using any enrichment) will, of course, be performed on a cycle-by-cycle basis as part of the reload safety evaluation process. Each reload design is evaluated to confirm that the cycle core design adheres to the limits that exist in the accident analyses and Technical Specifications to ensure that fuel handling and reactor operation is acceptable. Such analyses are performed using approved methodologies as defined in Technical Specification 5.6.5, "COLR" and evaluated in accordance with Title 10, Part 50, Section 59 of the Code of Federal Regulations, "Changes, Tests and Experiments".

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ENVIRONMENTAL ASSESSMENT

Summary:

The environmental effects of proposed allowed storage of fuel with increased enrichment and spent fuel pool criticality calculations justifying the proposed changes were evaluated in terms of radiological consequences, concerning both normal and accident conditions. Radiological consequences are only indirectly affected by increasing fuel enrichment. The radiological consequences are primarily a function of operating power and burnup. The purpose of increased fuel enrichment is the ability to produce the same power level for a longer period of time before refueling. Therefore, the proposed allowed storage of fuel with increased enrichment in the spent fuel pool would have no effect on authorized operating power levels but would result in increasing the burnup levels that can be practically achieved. The proposed Technical Specification Amendments do not affect the allowed maximum burnup for Palisades. This limit is determined through approved assembly and core design methodology and stated in the Palisades Final Safety Analysis Report as updated. The evaluation of the radiological consequences resulting from fuel handling accidents (and other accident and transient conditions) does not change since the maximum allowed fuel burnup remains unchanged.

Although the Palisades Technical Specifications will be modified to specify the above-mentioned fuel as acceptable for storage in the new fuel or spent fuel storage racks, evaluations of reload core designs (using any enrichment) will, of course, be performed on a cycle-by-cycle basis as part of the reload safety evaluation process. Each reload design is evaluated to confirm that the cycle core design adheres to the limits that exist in the accident analyses and Technical Specifications to ensure that reactor operation is acceptable. These proposed changes for allowed fuel storage do not result in changes in amounts of any radiological effluents that may be released offsite. There is no significant increase in the allowable individual or cumulative occupational radiation exposure. The change in allowed enrichment levels will have no effect on analyzed doses to the public, given a postulated accident causing damage to spent fuel. Therefore, doses to the public from fission product inventory release remain well within 10 CFR, Part 100 limits, and would be acceptable.

The proposed changes to the Technical Specifications involve systems located within the restricted area, as defined in Title 10 Part 20 of the Code of Federal Regulations. They do not affect non-radiological plant effluents and have no other environmental impact.

Therefore, Nuclear Management Company concludes that there are no significant radiological or non-radiological environmental impacts associated with the proposed amendment.

Details:

This License Amendment Request proposes revisions to the Technical Specifications associated with controlling the storage of assemblies with higher initial enrichments, different enrichment and burnup combinations, and the consideration of decay time. The proposed Technical Specification changes also include changes to several Limiting Conditions for Operation (LCO) and to Surveillance Requirements (SR) to enhance the control of the boron concentration in the spent fuel pool under normal and accident conditions. The following sections detail the proposed changes and provide a short explanation of the purpose of the

change. In addition, an evaluation of possible environmental impacts associated with each change is provided.

A. Changes to Technical Specifications Associated with the Fuel Pool in General

1. Change the Applicability of LCO 3.7.15 from:

   "When fuel assemblies are stored in the SFP and a verification of the stored assemblies has not been performed."

   to:

   "When fuel assemblies are stored in the Spent Fuel Pool."

   This is a more restrictive change.

2. Delete Required Action A.2.2 since verification alone would no longer restore the plant to analyzed conditions. Required Action A.2.1 is renumbered to "A.2."

The existing LCO is aimed at protecting against criticality during a fuel handling accident or misloading event. Criticality analyses which are the basis for this license amendment request credit boron for normal storage as well as for accident scenarios. Therefore, the applicability of Section 3.7.15 is extended to all times when fuel assemblies are stored in the Palisades fuel pool and Action A.2.2 is eliminated.

The change in applicability effectively increases the minimum surveillance requirements for spent fuel boron since samples now must be taken even if loading has been verified. Since Palisades administrative procedures currently require these samples at least weekly, this change has no effect on plant operations and does not result in a change to individual or cumulative occupational radiation exposure limits. Similarly, the changed surveillance does not result in a change to radiological or non-radiological effluent releases during normal or accident scenarios.

B. Technical Specification Changes Associated with the New Fuel Storage Rack

1. Change the allowed enrichment in Specification 4.3.1.3.a from:

   "Fuel assemblies having a maximum average planar U_{235} enrichment of 4.20 weight percent"

   to:

   "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."*

2. Delete existing Specification 4.3.1.3.c

3. Renumber existing Specification 4.3.1.3d to 4.3.1.3c

Since the new fuel storage racks are not used to store irradiated fuel, radiological consequences associated with changes in storage limitations are largely limited by the prevention of inadvertent criticality. The criticality analyses which are the basis for this license amendment show that the 95/95 k_{eff} for the new fuel storage rack is less than 0.95 assuming enrichment up to 4.05 wt% U-235 when fully loaded with 36 un-irradiated assemblies. The analyses also show the 95/95 k_{eff} for the new fuel storage rack is less than 0.95 when loaded with only 24 un-irradiated assemblies with enrichment up to 4.95 wt% U-235. The center row of the rack is left empty under this configuration. Figure 3 from EA-SFP-99-03 provides a graphical description of both loading patterns. EA-SFP-99-03 was provided for NRC review with our March 2, 2001 letter. The figure shows ½ of the new fuel storage rack. The loading pattern continues through the other half of the rack. The design basis assembly is a 216 pin Palisades assembly. Earlier assembly types with less than 216 pins and guide tubes are considered bounded since their enrichment is less than or equal to 3.27 wt%. More importantly, all assemblies with less than 216 pins have been irradiated and cannot be stored in the new fuel storage racks. Any new designs other than that assumed in the calculation, including but not limited to different numbers of fueled pins, different pellet diameters, and different pellet densities, will need to be evaluated against the design basis calculation and in accordance with Title 10, Part 50, Section 59 of the Code of Federal Regulations, "Changes, Tests and Experiments" before being stored in the racks.

Storage of higher enriched fresh fuel assemblies in the new fuel storage racks under specific loading patterns has no effect on non-radiological effluent releases.

C. Technical Specification Changes Associated with Region I Fuel Pool Storage

1. Change the allowed enrichment in 4.3.1.1.a from:

"having a maximum enrichment of 4.40 weight percent"

to:

"having a maximum planar average U-235 enrichment of 4.95 weight percent."

2. Change Specification 4.3.1.1.d from:

"Assemblies with enrichments above 3.27 weight percent U_{235} must contain 216 rods which are either UO_2, $Gd_2O_3UO_2$, or solid metal."

to:

"New or irradiated fuel assemblies."

The criticality analyses which are the basis for this license amendment request show that the 95/95 k_{eff} for the Region I fuel storage racks is less than 0.95 assuming the enrichment of an assembly is less than or equal to 4.95 wt% U-235. The design basis assembly is a 216 pin Palisades assembly. Earlier assembly types with less than 216 pins and guide tubes are considered bounded since their maximum enrichment is less than or equal to 3.27 wt%. Hence the calculation bounds all assemblies currently stored at Palisades and those foreseen in the future. Any new designs other than those assumed in the calculation, including but not limited

to different numbers of fueled pins, different pellet diameters, and different pellet densities, will need to be evaluated against the design basis calculation before being stored in the racks. In addition, prior to use in the Palisades core, new fuel designs are evaluated as part of the reload safety evaluation to ensure the cycle core design adheres to the limits that exist in the accident analyses and technical specifications. Such analyses are performed using approved methodologies as defined in Technical Specification 5.6.5, "COLR" and evaluated in accordance with Title 10, Part 50, Section 59 of the Code of Federal Regulations, "Changes, Tests and Experiments".

In itself, increasing the enrichment level allowed for storage in the Region I fuel pool racks has no effect on possible radiological or non-radiological effluent releases. Since the criticality design calculations show that k_{eff} remains below 0.95 in all normal storage and accident scenarios, there is no increased threat of radiation exposure due to accidental criticality in the fuel pool. Should Palisades pursue reload enrichments higher than the current storage limit (i.e. > 4.40 wt%) the result would not adversely impact the environmental effects since radiological impacts are only indirectly affected by increasing fuel enrichment. The radiological impacts are primarily a function of operating power and burnup. The purpose of increased fuel enrichment is the ability to produce the same power level for a longer period of time before refueling. Therefore, the proposed allowed storage of fuel with increased enrichment in the spent fuel pool would have no effect on authorized operating power levels but would result in increasing the burnup levels that can be practically achieved. Again, use of fuel (at any enrichment and burnup) is evaluated on a cycle-by-cycle basis to ensure that parameters such as assembly discharge burnups are within limits specified in the Final Safety Analysis Report.

D. Technical Specification Changes Associated with Region II Fuel Pool Storage

1. Change the LCO 3.7.16 from:

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

   to:

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

   This change adds the decay time of each assembly as an additional requirement for storage in Region II.

2. Similarly, change SR 3.7.16.1 from:

   "Verify by administrative means that the initial enrichment and burnup of each spent fuel assembly stored in Region II is in accordance with Table 3.7.16-1."

   to:

   "Verify by administrative means that the combination of initial enrichment, burnup, and decay time of each irradiated fuel assembly stored in Region II is in accordance with Table 3.7.16-1."

3. Replace Table 3.7.16-1 with Table 4 from EA-SFP-99-03.

4. Change the allowed enrichment in Specification 4.3.1.2.a from:

   "having a maximum enrichment of 3.27 weight percent"

   to:

   "having a maximum planar average U-235 *enrichment of 4.60 weight percent."*

5. Add a new specification 4.3.1.2.b that states:

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

6. Renumber existing specification 4.3.1.2.b to 4.3.1.2.c and revise the leading phrase from:

   "k_{eff} 0.95 if fully flooded with unborated water,"

   to:

   "k_{eff} 0.95 if fully flooded with water borated to 850 ppm,"

7. Renumber Specifications 4.3.1.2.c and 4.3.1.2.d. Change Specification 4.3.1.2.e (former 4.3.1.2.d) from:

   "*New or partially spent fuel assemblies which meet the initial enrichment and burnup requirements of Table 3.7.16-1.*"

   to:

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

8. Add a new figure, Figure 4.3-1; Figure 3 from EA-SFP-99-03.

The criticality analyses which are the basis for this license amendment show that the 95/95 k_{eff} for the Region II fuel storage racks is less than 0.95 assuming the enrichment of an assembly is less than or equal to 4.60 wt% U-235 and assuming 850 ppm boron in the pool water. The analyses also ensure k_{eff} < 1.0 assuming 0.0 ppm boron. Table 3.7.16--1 as revised in this amendment contains the burnup, enrichment and decay time combinations shown acceptable in EA-SFP-99-03.

Boron is already present in the Palisades spent fuel pool. Likewise, the fuel stored in the pool is burned to levels dictated by core design constraints. Assemblies naturally decay as they are stored. These characteristics of the fuel are not being changed by the proposed technical specification. Therefore, crediting the reactivity effects associated with boron, burnup and decay in the design basis criticality calculations has no effect on possible radiological or non-

radiological effluent releases. Since the criticality design calculations show that k_{eff} remains below 0.95 in all normal storage and accident scenarios, there is no increased threat of radiation exposure due to accidental criticality in the fuel pool.

In general, the proposed burnup and enrichment combinations that are acceptable for storage in the Region II racks require higher burnups for a given enrichment than those present in the current Technical Specification Table 3.7.16-1. This increase in allowed minimum burnup does not affect radiological consequences since the actual fuel burnup is dictated by core design constraints and may be significantly higher than that required for storage in Region II (up to 58,900 MWD/MTU assembly average for recent Palisades reload fuel).(1) In general, higher burnup has a limited effect on the short-lived isotope inventory in the fuel due to the development of an equilibrium condition between production and decay. Instead, extended burnups increase the fraction of the short-lived isotopes that migrate into the fuel-clad gap region.(2) With increasing burnup there is no decrease in fuel rod integrity or the probability of fuel failures during normal operations, as long as actual burnup does not exceed the vendor approved values. However, with the increased short-lived activity in the clad-gap region, increased burnup could result in increased activity being released into the reactor coolant under normal operation were fuel failures to occur. Again, maximum fuel burnup limits are not being changed in conjunction with this proposed amendment.

CONCLUSIONS

The proposed changes to the Palisades Technical Specifications discussed above relate the storage of new and irradiated fuel. These changes are consistent with the criticality evaluations which will be the design basis supporting the revised specifications. The Palisades Technical Specification section 4.2 "Reactor Core" does not specify an enrichment limit or fuel rods per assembly for use in the Palisades reactor core. The fuel design, including any changes, is evaluated for each new reload. This ensures that Palisades' core design satisfies the safety limits as defined in Palisades Technical Specifications Section 2.1. Such analyses are performed using approved methodologies as defined in Technical Specification 5.6.5, "Core Operation Limits Report (COLR)" and evaluated in accordance with Title 10, Part 50, Section 59 of the Code of Federal Regulations, "Changes, Tests and Experiments". This approach is consistent with United States Nuclear Regulatory Commission statements relating to Amendment 140 to the Palisades Facility Operating License.(3,4) It is concluded that the increased allowed enrichment (up to 4.95 weight percent) for storage and the changes to the criticality calculations supporting the revised storage constraints will not have an adverse environmental effect.

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1 FSAR Section 3.2.3
2 NUREG/CR-5009, "Assessment of the Use of Extended Burnup Fuel in Light Water Power Reactors", Prepared for the U.S. Nuclear Regulatory Commission by Pacific Northwest Laboratory.
3 Docket No. 50-255, Palisades Plant, *"Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 140 to Facility Operating License No. DPR-20"*, Consumers Power Company, Palisades Plant. L. Kopp Principal Contributor, Dated January 23, 1992. (TAC No. M82060)
4 Docket No. 50-255, Palisades Plant, *"Environmental Assessment and Finding of no Significant Impact"*, USNRC, Provided via letter from Brian Holian (USNRC) to Gerald Slade (Consumers Power Company) dated January 22, 1992. (TAC No. M82060)