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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 143 TO FACILITY OPERATING LICENSE NO. DPR-20

CONSUMERS POWER COMPANY

PALISADES PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated November 1, 1991, Consumers Power Company submitted a proposal to amend the Technical Specification (TS) to Facility Operating License DRP-20 for Cycle 10 operation of the Palisades Plant. The evaluation for Cycle 10 operation is provided in the Siemens Nuclear Power Corporation (SNP) report EMF-91-176 entitled, "Palisades Cycle 10: Disposition and Analysis of Standard Review Plan Chapter 15 Events."

The report documents the results of the disposition and analysis of the FSAR Chapter 14 events in support of Palisades Cycle 10 operation with up to 15.0% steam generator tube plugging. The events were evaluated in accordance with Chapter 15 of the Standard Review Plan (SRP) and SNP methodology. The changes that are proposed to be implemented for Cycle 10 include (1) the insertion of the second full reload of fuel that uses High Thermal Performance (HTP) grid spacers; (2) an increase in assembly radial power peaking to accommodate a low radial leakage loading pattern; (3) the inclusion of eight partial shielding assemblies (PSA) in low powered peripheral locations to reduce vessel fluence; (4) Reactor Protection System set point modifications (FC-888); and (5) Main Feedwater Control upgrade (FC)-920.

The large break loss-of-coolant accident (LBLOCA) analysis is summarized in the SNP report EMF-91-177, entitled "Palisades Large Break LOCA/ECCS Analysis with Increased Radial Peaking and Reduced ECCS Flow." The analysis supports the following primary changes:

- A reduction in emergency core cooling system (ECCS) flow due to a change in the Low Pressure Safety Injection (LPSI) flow curve and the assumed loss of a High Pressure Safety Injection (HPSI) pump, along with a LPSI pump when the worst single failure is considered (i.e., one emergency diesel generator).

- To bound future cycles an assembly radial peaking limit of 1.76 and a peak rod radial peaking limit of 2.04 were used.

- A 5 mil increase in the pellet diameter (i.e., reduction in the pellet-to-clad gap)

- An increase in pellet density to 94.5% of the theoretical density.
- An increase in minimum Technical Specification safety injection tank (SIT) level.

2.0 EVALUATION

Cycle 10 of the Palisades Plant is designed to operate at 2530 MWt. The plant safety analyses, both LOCA and non-LOCA have been performed to support Palisades Cycle 10 operation with:

- Steam generators with up to 15% tube plugging.
- A fuel rod peaking factor limit of 1.92 for all fuel assembly types.
- An increase in assembly peaking factor limit from 1.57 for reload M to 1.66 for reload N (216 fuel rods per assembly) to accommodate a low radial leakage loading pattern. The peaking factor limit for 208 fuel rods per assembly, reload L, remains the same at 1.48.
- Inclusion of eight partial shielding assemblies (PSA) in low powered peripheral locations to reduce vessel fluence.
- Modifications in the Reactor Protection System set points.
- Upgrades to the Main Feedwater Controller.

The changes specific to Cycle 10 operation are necessary due to the changes to the fuel design (reload N) and the fuel management scheme for a low leakage core. For Cycle 10 only minimum DNBR calculations were performed. The Cycle 9 transient analysis (ANF-90-078, (Ref. 5)) still bounds the thermal hydraulic response for events identified as requiring DNB analysis. The operating parameters as described in sections 15.0.1 through 15.0.8 of EMF-91-176 remain applicable for the Cycle 10 analysis relative to the Cycle 9 analysis.

Several factors offset the loss in DNB margin from the increased assembly radial peaking. They include: (1) use of the Advanced Nuclear Fuels (ANFP), critical heat flux correlation, (2) use of the HTP spacer fuel, (3) improved reload N specific fuel design, and (4) less limiting axial shape characteristic of full power control rod position.

Non-LOCA Transient Analysis

The basis for event selection is documented in the Disposition and Analysis of Events report (Ref. 3). Listed below are the SRP Chapter 15 events that were reanalyzed for the Cycle 10 submittal:

Increase in Heat Removal by the Secondary System

15.1.3 Increase in Steam Flow

Decrease in Reactor Coolant System Flow

15.3.1 Loss of Forced Reactor Coolant Flow
15.3.3 Reactor Coolant Pump Rotor Seizure

Reactivity and Power Distribution Anomalies

15.4.2 Uncontrolled Control Rod Bank Withdrawal at Power Operation Conditions
15.4.3 Control Rod Misoperation
(1) Dropped Control Bank/Rod
(5) Single Control Rod Withdrawal

Decreases in Reactor Coolant Inventory

15.6.1 Inadvertent Opening of a PWR Pressurizer Pressure Relief Valve

The events that were reanalyzed were all found to meet the staff's acceptance criteria of no centerline melt and no DNB in the hottest fuel rod.

LOCA Analysis

The changes for Cycle 10 will not affect the relative severity between the LBLOCA and small break LOCA (SBLOCA). The licensee reviewed the significant parameters for SBLOCA listed in the FSAR for Palisades. The review indicated that the parameters assumed the reference SBLOCA analysis bound the corresponding values for Cycle 10.

The Cycle 10 LBLOCA analysis was performed assuming that the Palisades plant was operating at 2582 MWt (2530 MWt + 2% uncertainty) and incorporates a maximum average steam generator tube plugging level of 29.3% with up to 4.5% asymmetry in the system blowdown, hot channels, and reflood calculations. The changes supported by this analysis do not affect the limiting break size identified by SNP's LOCA methodology since the changes do not effect system blowdown. Therefore, the break limiting size of a 0.6 double ended guillotine break (DECLG) at the pump discharge, as previously identified, for Cycle 8 analysis was used.

The results of the Cycle 10 analysis demonstrate that the 10 CFR 50.46 criteria are met for Palisades plant with the axially dependent power peaking limit curve in Figure 2.1 of EMF-91-177. The analysis also supports a maximum linear heat ratio (LHR) of 15.28 kw/ft up to a relative core height of 0.6 and a LHR of 14.75 kw/ft up to a relative core height of 0.8. A total radial peaking factor of 2.04 and a maximum average steam generator tube plugging of 29.3% with up to 4.5% asymmetry are supported. The peak cladding temperature was calculated to be 1926.5 degrees F for the beginning of cycle (BOC) profile and 2110.6 degrees F for the end-of-cycle (EOC) profile. The analysis supports Cycle 10 operation and the staff finds this acceptable.

Safety Injection Boron Concentration

The licensee completed an analysis of post LOCA long term cooling to determine the effect of raising the boron concentration limit for the SITs and the Safety Injection and Refueling Water (SIRW) tank from 2000 ppm to 2500 ppm.

Since several plant parameters of the previous analysis have been changed or will be changed with the proposed increase in boron concentration. These changes are:

- An increase in the SITs level from 198" to 200," corresponding to a total liquid inventory increase of approximately 2308 lbm.

- An increase in the boron concentration limit from 2000 ppm to 2500 ppm, corresponding to an increase from 1.13 wt % boric acid to 1.43 wt % boric acid.

- The Technical Specification concentration limit of the boric acid storage tank (BAST) is 10 wt % where as 12 wt % was used in the current longterm cooling (LTC) calculation.

- Installation of new power operated relief valves (PORVs) with larger effective throat area that are used for long term cooling following SBLOCA.

The available margin in boric acid concentration from the LTC analysis for both large break and small break LOCAs was evaluated for the effect from increasing the boric acid concentration of the SITs and the SIRW tank by 0.3 wt%. The effect of increasing the boric acid limit of the SITs and SIRW tank from 2000 ppm to 2500 ppm is an increase of 0.2 wt% boric acid in the containment sump. This is insignificant when compared to excess margin available. A large excess margin stems from conservative assumptions in the analysis regarding the period of injection from the high concentration BAST (12%) versus the period of injection from the lower concentration SIRW and SIT (1.43%). The staff has reviewed the licensee's analysis and finds the increase in the boron concentration to 2500 ppm acceptable.

Fuel Handling Design Basis Accident

Since the licensee plans to use extended burnup fuel enriched to greater than 4.0 w/o U_{235}, the staff reanalyzed the fuel handling design basis accident (DBA) for this case. As noted in NUREG/CR-5009 "Assessment of the Use of Extended Burnup Fuel in Light Water Power Reactors," February 1988, increased burnup could increase offsite doses from the fuel handling accident by a factor of 1.2 due to the fact that the calculated iodine gap-release fraction for some high power fuel designs is increased by 20%.

Thus, the staff conservatively assumed an increased gap fraction of 0.12 as compared to the previously assumed gap-release fraction of 0.10 for iodine for the spent fuel handling accident.

The spent fuel assembly drop consequences analyzed in the Palisades SER were previously calculated by the staff to be 9 rem (thyroid) at the exclusion area boundary. With the 20% increase in radioiodine gap activity described in NUREG/CR-5009, the calculated radiological consequences at the exclusion area boundary would increase to 10.8 rem thyroid. The resultant calculated thyroid dose of 10.8 rem is well within the guideline values of 10 CFR Part 100 and meets the acceptance criterion of SRP 15.7.4, "Radiological Consequences of Fuel Handling Accidents," that calculated doses should be well within the guideline values of 10 CFR Part 100. The staff finds the TS changes proposed by the licensee, with respect to the radiological aspects of the planned changes, acceptable.

3.0 CONCLUSION

The staff has reviewed the modifications to the Palisades Technical specifications and the reload configurations for Cycle 10 and finds them acceptable.

The staff has also reviewed the licensee's proposal to increase the boron concentration, from 2000 ppm to 2500 ppm, in the SITs and the SIRW tank. We find that the increase is insignificant when considering the available margin and the conservatism incorporated. This change will not compromise the capability for post LOCA long term cooling and is, therefore, acceptable.

4.0 STATE CONSULTATION

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

5.0 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. 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 this amendment involves no significant hazards consideration and there has been no public comment on such finding (56 FR 64653). Accordingly, this 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 this amendment.

6.0 CONCLUSION

The staff 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.

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7.0 REFERENCES

1. Letter from G.B. Slade, Consumers Power to USNRC, "Palisades Plant - Technical Specifications Change Request - Cycle 10 Fuel Design and Safety Injection Boron Concentration," November 1, 1991.

2. "Palisades Large Break LOCA/ECCS Analysis with Increased Radial Peaking and Reduced ECCS Flow," EMF-91-177, Siemens Nuclear Power Corporation, Richland, WA 99352, October 1991.

3. "Palisades Cycle 10: Disposition and Analysis of Standard Review Plan Chapter 15 Events," EMF-91-176, Siemens Nuclear Power Corporation, Richland, WA 99352, October 1991.

4. "Effect of Increased SIRW Tank Boron Concentration on Long Term Cooling," EA-PAH-91-04, Consumers Power Corporation, November 1, 1991.

5. "Palisades Cycle 9: Analysis of Standard Review Plan Chapter 15 Events," ANF-90-078, Advanced Nuclear Fuels Corporation, September 1990.