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June 30, 2000

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**DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT**
ANNUAL REPORT OF CHANGES IN ECCS MODELS PER 10 CFR 50.46

Attached is the annual report of changes in Emergency Core Cooling System (ECCS) models for the Palisades plant. The report is submitted in accordance with 10 CFR 50.46(a)(3)(ii). The report contains both the ABB-CE Small Break Loss of Coolant Accident (SBLOCA) ECCS Evaluation Summary and the Siemens Power Corporation (SPC) EXEM PWR Large Break Evaluation Summary. This report covers the period from January 1999 through December 1999.

SUMMARY OF COMMITMENTS

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

Robert A Quest for

Nathan L. Haskell
Director, Licensing & Performance Assessment

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

Attachment

A001

ATTACHMENT

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

June 30, 2000

# ANNUAL REPORT OF CHANGES IN ECCS MODELS PER 10 CFR 50.46

3 Pages

## ANNUAL REPORT OF CHANGES IN ECCS MODELS PER 10 CFR 50.46

### ABB-CENP SBLOCA ECCS EVALUATION SUMMARY

Asea Brown Boveri-Combustion Engineering Nuclear Power (ABB-CENP) division performed the Palisades small break loss of coolant accident (SBLOCA) design basis analysis for fuel cycle 14. The Peak Cladding Temperature (PCT) was determined to be 2026 °F and was reported in Reference 1. During 1999, there were no changes or errors in the ABB CENP SBLOCA evaluation models that affect the cladding temperature. The Cycle 14 SBLOCA analysis was dispositioned as applicable to Cycle 15 operation (which began in December, 1999).

### SPC EXEM PWR LBLOCA ECCS EVALUATION SUMMARY

Siemens Power Corporation evaluates the Palisades large break loss of coolant accident (LBLOCA) with the EXEM PWR methodology. The methodology consists of four primary computer codes: RELAP4 to compute the system and hot channel response; RFPAC to compute the containment pressures, reflood rates, and axial shape factors; TOODEE2 to calculate the hot rod heatup; and RODEX2 to determine the rod conditions at the start of the transient.

As reported in Reference 1, the licensing basis LBLOCA PCT of 1869 °F was adjusted to 1834 °F due to errors discovered during the previous reporting period. Between January 1, 1999 and December 31, 1999, several additional errors in the methodology were identified. The sum of the absolute values of these errors is 2 °F. The sum net effect of these errors on PCT is –2 °F. Cumulative adjustments to the LBLOCA PCT yield a licensing basis PCT of 1832 °F on December 31, 1999. Specific errors are discussed below. Details are taken from Attachment 1 of Reference 2.

<u>Corrosion Model in the Version of RODEX2 Used by Safety Analysis</u>

Siemens Power Corporation discovered that the NRC approved corrosion model in ANF-88-133(P) was not incorporated into RDX2LSE. Other coding errors in the MATPRO corrosion model of RDX2LSE were also identified. RDX2LSE is used to calculate fuel rod characteristics (e.g., gap conductance, stored energy) that are inputs for transient and LOCA analyses. The MATPRO corrosion model has been corrected in the RDX2LSE version uoct98. The PCT impact on the Palisades LBLOCA analysis (MATPRO coding and ANF-88-133(P) corrosion modeling) was estimated to be –2 °F.

## ANNUAL REPORT OF CHANGES IN ECCS MODELS PER 10 CFR 50.46

RDX2LSE Fission Gas Release Calculation for Gadolinia Fuel

In previous versions of the RDX2LSE code, the fission gas release subroutine used the theoretical density (TD) for $UO_2$ rather than the TD for $UO_2$-$Gd_2O_3$ for gadolinia rod fission gas release calculations. Correction of the error results in a lower stored energy and a lower PCT for gadolinia rods. Since the PCT for gadolinia fuel rods is significantly less than the limiting PCT for $UO_2$ fuel rods, there is no impact on the reported limiting PCT. For LBLOCA analyses, the PCT impact of the change was estimated to be 0 °F for Palisades.

ICECON Coding Errors Found During ICECON Verification

A number of errors were identified in the ICECON portion of the RFPAC code related to the calculation of containment heat transfer. ICECON is used in the PWR LBLOCA methodology to calculate the containment response. The errors outlined below were evaluated together as a closely related group.

1. The Uchida heat transfer coefficient was in error for a mass ratio of 0.5.
2. The species thermal conductivities, specific heats, viscosities, and molecular weights were reversed when calculating mixture values.
3. Two conversion factors used in calculating steam conductivity were found to be in error and were corrected.
4. A parenthesis ")" was misplaced in calculating the mass transfer coefficient.
5. The correlation used to define saturation pressure as a function of temperature was not properly extended for low temperature ice condenser calculations.
6. An error in calculating the parameter UPOLF2 was corrected.
7. A units problem associated with the steam viscosity tables was corrected.
8. The energy transported into a compartment by normal leakage and penetration leakage was corrected.

The impact of this group of changes on the PCT for Palisades was estimated to be 0 °F.

Error in Flow Blockage Model in TOODEE2

An error was identified in the flow diversion model relating to fuel rod swelling used for LBLOCA analyses. The available flow area when a fuel rod was calculated to have ballooned sufficiently to touch adjacent rods was incorrectly computed. The TOODEE2 code was modified to correct the error. The impact of this change on the PCT for Palisades was estimated to be 0 °F.

## ANNUAL REPORT OF CHANGES IN ECCS MODELS PER 10 CFR 50.46

Modification of TOODEE2 Code for Exact Solution of QMAX

A change was made to the TOODEE2 code related to the calculation of the variable QMAX above the 10.333 foot elevation. QMAX is used in the calculation of the heat transfer coefficients during the LBLOCA reflood period. In the original implementation of the variable QMAX into TOODEE2, an approximation was made in solving the equation defining QMAX. An exact solution of the equation is possible and the code has been modified to reflect this. The impact of this change on the PCT for Palisades was estimated to be 0 °F.

**References:**


1. Letter, N. L. Haskell (Consumers Energy) to Document Control Desk (NRC), "Annual Report of Changes in ECCS Model Per 10 CFR 50.46" dated October 29, 1999.

2. Letter, J. F. Mallay (Siemens Power Corporation) to Document Control Desk (NRC), "1999 – Annual Reporting of Changes and Errors in ECCS Evaluation Models" dated February 23, 2000.