Wisconsin Electric POWER COMPANY
231 W. MICHIGAN, P.O. BOX 2046, MILWAUKEE, WI 53201

January 9, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. NUCLEAR REGULATORY COMMISSION
Washington, D. C. 20555

Dear Mr. Denton:

DOCKET NOS. 50-266 AND 50-301
FUEL CLADDING RUPTURE, STRAIN, AND FLOW
BLOCKAGE MODELS FOR ECCS ANALYSES
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

Your letters dated November 9 and November 27, 1979, requested a confirmation of the representations made on our behalf by Westinghouse Electric Corporation concerning the fuel cladding rupture, rupture strain, and fuel assembly flow blockage models used in our ECCS analyses, in view of the data and models presented in the draft report NUREG-0630, Cladding Swelling and Rupture Models for LOCA Analysis. These representations were made in a Westinghouse letter (NS-TMA-2147) dated November 2, 1979, and were subsequently revised by letters NS-TMA-2158 and -2163 dated November 16, 1979, and NS-TMA-2174 dated December 7, 1979. Discussions of these representations took place on November 13, December 6, and December 20, 1979, between representatives of Westinghouse and your Staff. Methods for calculating interim penalties were agreed upon by your Staff in those discussions. In addition, interim benefits to the analyses results which could be taken into account for recently submitted improvements to the Westinghouse large-break evaluation model were also agreed upon by your Staff. The evaluation of these ECCS analytical model considerations provided in the attachment demonstrate that plant operation may continue until differences between the fuel rod models of concern are resolved.

Wisconsin Electric Power Company has received from Westinghouse the results of technical evaluations of the impact of draft report NUREG-0630 cladding models on the most recent large-break ECCS analyses for Point Beach Nuclear Plant. These analyses assume eighteen percent steam generator tube plugging and reactor coolant system operation at both 2000 and 2280 psia and the results are applicable to the current operating modes of Point Beach Nuclear Plant Units 1 and 2, respectively. This evaluation conservatively applied the penalties and benefits to the existing ECCS analyses and the results are shown in the attachment to this letter.

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In the November 2, 1979 Westinghouse letter (NS-TMA-2147) to you, it was stated that heat-up rate dependence was already factored into small-break LOCA analyses. The small-break LOCA analyses for Point Beach Nuclear Plant were performed using the "August, 1974" Westinghouse small-break evaluation model, which does not employ heat-up rate dependent fuel rod burst curves. The "October, 1975" model is the model which has heat-up rate dependence factored into it. This lack of heat-up rate dependence in the small-break analyses of Point Beach is not a safety concern for the following reasons:

1. The "October, 1975" model contains analytical model improvements which have always resulted in a reduction of the calculated peak clad temperature (PCT) in other Westinghouse plants over that calculated by the "August, 1974" model. This would also be the case for Point Beach.

2. The results of the Point Beach small-break analyses show that no hot rod burst occurs and that PCT is only 1367°F so that the large-break LOCA is always the limiting LOCA for ECCS evaluation.

Only the limiting large-break ECCS analyses, therefore, need to be re-evaluated, as described above.

The results of the evaluations demonstrate that both units of Point Beach continue to meet all of the ECCS acceptance criteria of 10 CFR 50.46 without any reduction in the heat flux hot channel peaking factor (F_Q). These interim results are extremely conservative for the following reasons:

1. The penalties assessed are maximum potential values, and the benefits allowed are minimum values.

2. A hot fuel assembly flow blockage of 75% was unrealistically assumed where 0% blockage was calculated previously for Point Beach. (The average hot assembly rod was not calculated to burst.)

3. The Westinghouse heat-up rate dependent burst curves were used for an additional ECCS evaluation of Point Beach, and the results showed no increase in the PCT (Point Beach was Plant No. 18 in Westinghouse letter NS-TMA-2163 dated November 16, 1979).

Final resolution of this issue will be achieved when the differences between the fuel rod models are resolved by Westinghouse and members of your staff.

Very truly yours,

Executive Vice President

Sol Burstein

Attachment

ATTACHMENT

I. Evaluation of the Potential Impact of Using Draft NUREG-0630 Fuel Rod Models in the Point Beach Nuclear Plant (PBNP) Loss of Coolant Accident (LOCA) Analyses

A. Previous Point Beach Nuclear Plant ECCS Analyses Results

The evaluation is performed on the two most limiting LOCA analyses for PBNP which are identified below:

Assumptions	Unit 1	Unit 2
Break Type and Location	Double-Ended Cold Leg Guillotine	
Westinghouse ECCS Evaluation Model	"February, 1978"	
Break Discharge Coefficient	0.4	0.4
Initial Core Power	102 Percent of 1518.5 MWt	
Heat Flux Hot Channel Peaking Factor (F_Q)	2.32	2.32
Steam Generator Tube Plugging	Eighteen (18) Percent (Uniform)	
Initial Reactor Coolant Pressure (psia)	2000	2280

Calculated Results	Unit 1	Unit 2
Hot Rod Maximum Temperature for the Burst Region of the Clad (PCT_B)(°F)	1932	1929
Hot Rod Burst Elevation (ft.)	5.75	5.75
Hot Rod Maximum Temperature for Non-Ruptured Region of the Clad (PCT_N)(°F)	2062	2053
Elevation of Maximum Temperature (ft.)	7.5	7.5
Clad Strain at the End of Blowdown at this Elevation (%)	1.3	1.5
Maximum Clad Strain at this Elevation	4.9	4.7
Core Reflood Rate at the Time of Maximum Temperature (inches/second)	< 1.0	< 1.0
Core Reflood Heat Transfer Mode at the Time of Maximum Temperature	"Steam Cooling"	
Hot Assembly Flow Blockage (%)	0.0	0.0

(No hot assembly average rod burst was predicted to occur)

B. Evaluation of the Maximum Potential Impact on the Burst Node Peak Clad Temperature for PBNP

The maximum potential impact on the peak clad temperature of the hot rod burst node is evaluated in terms of a core peaking factor (F_Q) penalty required to maintain the peak temperature below 2140°F (PBNP has an interim penalty of 60°F on the PCT limit pending final resolution of the upper plenum injection issue). The method of evaluation is fully explained in Westinghouse letter NS-TMA-2174 dated December 7, 1979. This method reduces the F_Q to maintain the PCT below the PBNP limit of 2140°F using the following bases from the letter:

1. $+0.01\ \Delta F_Q \leftrightarrow \sim -150°F\ \Delta PCT_B$
   (based on generic sensitivity studies);

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2. Use of the NRC Burst Model could require a maximum F_Q reduction of 0.015;

3. Use of the NRC Strain Model could require a maximum F_Q reduction of 0.03.

The calculation for the two Point Beach analyses is performed as follows:

ΔPCT_1 = the maximum PCT penalty on the hot rod burst node
= maximum total F_Q reductions converted to PCT penalty
= $(0.015 + 0.03)(150°F\ \Delta PCT_B/.01\Delta F_Q)$
= 675°F

ΔPCT_2 = the hot rod burst node PCT margin to the PBNP limit of 2140°F
= 2140°F - PCT_B
= 2140°F - 1929°F (Unit 2)
= 211°F (Unit 2) or 208°F (Unit 1)

ΔF_Q^B = F_Q reduction required to maintain the PCT of the burst node below 2140°F
= $(\Delta PCT_1 - \Delta PCT_2)\ (.01\ \Delta F_Q/150°F\ \Delta PCT_B)$
= (675°F - 211°F)(.01/150°F) (Unit 2)
= .04 (Unit 2 or Unit 1)

Therefore, the maximum potential impact of using the NRC fuel rod models for the hot rod burst node PCT is to require a core peaking factor reduction of .04 to maintain the PCT below the PBNP limit of 2140°F.

C. Evaluation of the Maximum Potential Impact on the Non-Burst Node Peak Clad Temperature for PBNP

The maximum potential impact on the peak clad temperature of the hot rod non-burst node, which is located above the burst node and occurs during the reflood phase of the LOCA, is evaluated in two steps. The first step evaluates the impact on the PCT of the NRC clad burst and strain models on the pellet-clad gap conductance prior to burst. Lower calculated strain with the use of the NRC models could result in increased gap conductance and higher clad temperatures. Since the maximum strain calculated with the use of the NRC models is identical to the original strain calculated during the blowdown phase of the accident, the maximum potential impact is evaluated by using the difference between the maximum and the blowdown strains. This evaluation assumes a 20°F increase in PCT per percent decrease in strain at the location of the PCT, based on several generic sensitivity studies. The calculation is shown below for PBNP:

ΔPCT_3 = the maximum PCT penalty on the hot rod, non-burst node prior to rod burst
= (Maximum strain - blowdown strain) $\dfrac{20°F\ \Delta PCT}{.01\ \Delta strain}$
= (.047 - .015)(20°F/.01) (Unit 2)
= 64°F (Unit 2) or 72°F (Unit 1)

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The second step evaluates the impact of the NRC burst and fuel assembly flow blockage curves on the calculated PCT. Since the maximum flow blockage indicated by the NRC curve is 75 percent, the potential PCT increase is calculated by increasing the currently calculated flow blockage to 75 percent. A PCT sensitivity formula based on generic sensitivity studies, which was explained in Westinghouse letter NS-TMA-2174 dated December 7, 1979, is used for the PBNP calculation as shown below:

ΔPCT_4 = the maximum PCT penalty on the hot rod, non-burst node following rod burst

$$= \frac{1.25°F\ \Delta PCT}{1\%\ \Delta blockage}\ (50\% - \text{Percent current blockage})$$

$$+ \frac{2.36°F\ \Delta PCT}{1\%\ \Delta blockage}\ (75\% - 50\%)$$

$$= \frac{1.25°F}{\%}\ (50\% - 0\%) + \frac{2.36°F}{\%}\ (75\% - 50\%)\ \text{(Unit 2)}$$

$$= 121°F\ \text{(Unit 2 or Unit 1)}$$

Note: If core reflood rate is greater than 1.0 inches/second, then $\Delta PCT_4 = 0$. This is not applicable to PBNP.

ΔPCT_5 = total impact on PCT of both steps

$$= \Delta PCT_3 + \Delta PCT_4$$

$$= 64°F + 121°F\ \text{(Unit 2)}$$

$$= 185°F\ \text{(Unit 2) or } 193°F\ \text{(Unit 1)}$$

The core peaking factor (F_Q) reduction required to maintain the PCT less than the PBNP limit of 2140°F is calculated using another formula from letter NS-TMA-2174 as shown below:

ΔF_Q^{NB} = F_Q reduction required to maintain the hot rod non-burst clad temperature less than 2140°F

$$= (PCT_N + \Delta PCT_5 - 2140°F)\left(\frac{.01\ \Delta F_Q}{10°F\ \Delta PCT}\right)$$

$$= (2053°F + 185°F - 2140°F)\left(\frac{.01}{10°F}\right)\ \text{(Unit 2)}$$

$$= .10\ \text{(Unit 2) or } .115\ \text{(Unit 1)}$$

II. The Minimum Potential Impact on LOCA Analyses Results of Using Improved Analytical Models

The effect on LOCA analyses results of using improved analytical and modeling techniques in the SATAN blowdown computer code has been analyzed. The results were submitted to the NRC staff for review. An initial review of those results by the staff has allowed the establishment of a credit to offset the penalties for the interim period. This credit is an increase in the allowable heat flux hot channel factor (F_Q) of +0.12 for two loop Westinghouse plants such as PBNP.

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III. Required Adjustment in Heat Flux Hot Channel Peaking Factor (F_Q)

The hot channel factor adjustment required to meet the PCT limit of 2140°F for PBNP is the allowable credit from Section II minus the maximum penalty from Sections I.B (the burst node) or I.C (the non-burst node):

ΔF_Q penalty = .12 - Maximum (.04 or .115), but not greater than zero
= 0

Therefore, no adjustment in F_Q is required for either unit at PBNP.

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