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April 10, 1981

Mr. Steven A. Varga, Chief
Operating Reactor Branch #1
Division of Licensing
Office of Nuclear Reactor Regulation
U. Nuclear Regulatory Commission
Wa ington, D.C. 20555

Subject: Zion Station Units 1 and 2
Interim Supplemental Analysis to Account for Cladding Swelling and Rupture Models for Zion Units 1 and 2 LOCA Analysis
NRC Docket Nos. 50-295 and 50-304

References: (a) October 22, 1979 letter from D. L. Peoples to H. R. Denton

(b) January 21, 1981 letter from S. A. Varga to J. S. Abel

(c) January 8, 1980 letter from D. L. Peoples to D. G. Eisenhut

Dear Mr. Varga:

In Reference (a) Commonwealth Edison Company submitted an application for license amendment to increase the total nuclear peaking factor, F_Q to 2.20.

Per Reference (b) the NRC Staff indicated that their review of that application was nearly complete. However, the NRC Staff indicated that additional information was necessary to complete their review. Specifically, the NRC Staff requested Commonwealth Edison to provide an interim supplemental analysis assessing the impact of:

1) A Westinghouse calculational error involving temperature - ramp rates used in cladding burst tests; and

2) NUREG-0630 models involving cladding swelling and rupture.

The supplemental analysis was to be similar to that provided by Commonwealth Edison in Reference (c); however, updated to include the appropriate parameters from the LOCA analysis submitted in Reference (a).

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Attachment 1 to this letter contains the requested interim supplemental analysis. In summary, this analysis indicates that the F_Q peaking factor limit of 2.20 identified in the LOCA analysis of Reference (a) must be reduced by 0.03 to offset penalties resulting from application of the NRC fuel rod models. Thus, the resultant F_Q peaking limit for Zion Units 1 and 2 becomes 2.17.

Attachment 2 contains the appropriate changes to the proposed technical specifications of Reference (a) necessitated by the interim supplemental analysis of Attachment 1.

The interim analysis (Attachment 1) and revised technical specifications (Attachment 2) have been reviewed and approved by Commonwealth Edison On-Site and Off-Site Review with the conclusion that the plant can be operated safely in accordance with the proposed changes.

Please address any questions that you might have concerning this matter to this office.

One (1) signed original and thirty-nine (39) copies of this letter are provided for your use.

Very truly yours,

T.R. Tramm

T. R. Tramm
Nuclear Licensing Administrator
Pressurized Water Reactors

cc: Resident Office - Zion

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ATTACHMENT 1

Zion Station Units 1 and 2
NRC Docket Nos. 50-295 and 50-304

Interim Supplemental Analysis

A. Evaluation of the potential impact of using fuel rod models presented in draft NUREG-0630 on the Loss of Coolant Accident (LOCA) analysis for Zion Units 1 and 2 .

This evaluation is based on the limiting break LOCA analysis identified as follows:

BREAK TYPE - DOUBLE ENDED COLD LEG GUILLOTINE

BREAK DISCHARGE COEFFICIENT 0.6

WESTINGHOUSE ECCS EVALUATION MODEL VERSION February 1978 w/UHI

CORE PEAKING FACTOR 2.20

HOT ROD MAXIMUM TEMPERATURE CALCULATED FOR THE BURST REGION OF THE CLAD - 1827.3 $^{o}F = PCT_B$

ELEVATION - 6.25 Feet.

HOT ROD MAXIMUM TEMPERATURE CALCULATED FOR A NON-RUPTURED REGION OF THE CLAD - 2048.3 $^{o}F = PCT_N$

ELEVATION - 7.5 Feet.

CLAD STRAIN DURING BLOWDOWN AT THIS ELEVATION 4.24 Percent
MAXIMUM CLAD STRAIN AT THIS ELEVATION - 10 Percent

Maximum temperature for this non-burst node occurs when the core reflood rate is greater than 1.0 inch per second and reflood heat transfer is based on the FLECHT calculation.

AVERAGE HOT ASSEMBLY ROD BURST ELEVATION - N/A Feet

HOT ASSEMBLY BLOCKAGE CALCULATED - 0 Percent

1. BURST NODE

The maximum potential impact on the ruptured clad node is expressed in letter NS-TMA-2174 in terms of the change in the peaking factor limit (FQ) required to maintain a peak clad temperature (PCT) of 2200^{o}F and in terms of a change in PCT at a constant FQ. Since the clad-water reaction rate increases significantly at temperatures above 2200 ^{o}F, individual affects (such as ΔPCT due to changes in several fuel rod models) indicated here may not accurately apply over large ranges, but a simultaneous change in FQ which causes the PCT to remain in the neighborhood of 2200.^{o}F justifies use of this evaluation procedure.

From NS-TMA-2174:

For the Burst Node of the clad:

- $0.01 \Delta FQ \rightarrow \sim 150^{o}F$ BURST NODE ΔPCT
- Use of the NRC burst model and the revised Westinghouse burst model could require an FQ reduction of 0.027
- The maximum estimated impact of using the NRC strain model is a required FQ reduction of 0.03

Therefore, the maximum penalty for the Hot Rod burst node is:

$$\Delta PCT_1 = (0.027 + 0.03)\ (150^{o}F/0.01) = 855.0^{o}F$$

Margin to the 2200°F limit is:

$$\Delta PCT_2 = 2200.^{o}F - PCT_B = \underline{\ 372.7\ }\ ^{o}F$$

The FQ reduction required to maintain the 2200°F clad temperature limit is:

$$FQ_B = (\Delta PCT_1 - \Delta PCT_2)\ \left(\frac{.01 \Delta FQ}{150^{o}F}\right)$$

$$= (855.0 - 372.7)\ \left(\frac{.01}{150}\right)$$

$$= \underline{\ 0.03\ }\ \text{(but not less than zero).}$$

2. NON-BURST NODE

The maximum temperature calculated for a non-burst section of clad typically occurs at an elevation above the core mid-plane during the core reflood phase of the LOCA transient. The potential impact on that maximum clad temperature of using the NRC fuel rod models can be estimated by examining two aspects of the analyses. The first aspect is the change in pellet-clad gap conductance resulting from a difference in clad strain at the non-burst maximum clad temperature node elevation. Note that clad strain all along the fuel rod stops after clad burst occurs and use of a different clad burst model can change the time at which burst is calculated. Three sets of LOCA analysis results were studied to establish an acceptable sensitivity to apply generically in this evaluation. The possible PCT increase resulting from a change in strain (in the Hot Rod) is +20.°F per percent decrease in strain at the maximum clad temperature locations. Since the clad strain calculated during the reactor coolant system blowdown phase of the accident is not changed by the use of NRC fuel rod models, the maximum decrease in clad strain that must be considered here is the difference between the "maximum clad strain" and the "clad strain at the end of RCS blowdown" indicated above.

Therefore,

$$\Delta PCT_3 = \left(\frac{20^{o}F}{.01\ strain}\right)\ (MAX\ STRAIN - BLOWDOWN\ STRAIN)$$

$$= \frac{20}{.01}\ (\underline{0.10} - \underline{0.0424})$$

$$= \underline{\quad 115.2 \quad}$$

The second aspect of the analysis that can increase PCT is the flow blockage calculated. Since the greatest value of blockage indicated by the NRC blockage model is 75 percent, the maximum PCT increase can be estimated by assuming that the current level of blockage in the analysis (indicated above) is raised to 75 percent and then applying an appropriate sensitivity formula shown in NS-TMA-2174.

Therefore,

$$\Delta PCT_4 = 1.25^{o}F\ (50 - PERCENT\ CURRENT\ BLOCKAGE) + 2.36^{o}F\ (75-50)$$

$$= 1.25\ (50 - \underline{\quad\quad}) + 2.36\ (75-50)$$

$$= \underline{\quad\quad\quad}\ ^{o}F$$

$$\Delta PCT_4 = 0.$$

If PCT_N occurs when the core reflood rate is greater than 1.0 inch per second, $\Delta PCT_4 = 0$. The total potential PCT increase for the non-burst node is then

$$\Delta PCT_5 = \Delta PDT_3 + \Delta PCT_4 = 115.2$$

Margin to the 2200°F limit is

$$\Delta PCT_6 = 2200^{o}F - PCT_N = 151.7$$

The FQ reduction required to maintain this 2200°F clad temperature limit is (from NS-TMA-2174).

$$FQ_N = (\Delta PCT_5 - \Delta PCT_6)\left(\frac{.01\ FQ}{10^{o}F\ \Delta PCT}\right)$$

FQ_N = $\underline{\quad 0 \quad}$ but not less than zero.

The peaking factor reduction required to maintain the 2200°F clad temperature limit is therefore the greater of ΔFQ_B and ΔFQ_N,

or, $\Delta FQ_{PENALTY}$ = $\underline{\ 0.03\ }$

B. The effect on LOCA analysis results of using improved analytical and modeling techniques (which are currently approved for use in the Upper Head Injection plant LOCA analyses) in the reactor coolant system blowdown calculation (SATAN computer code) has been quantified via an analysis which was submitted to the NRC for review on October 22, 1979 per a

D. L. Peoples to H. R. Denton letter. Assuming the benefits associated with those model improvements are approved, then the LOCA peaking factor limit, FQ, for Zion Units 1 and 2 is 2.20.

C. The peaking factor limit, FQ, identified in Section (B) above adjusted by the $\Delta FQ_{PENALTY}$ calculated in Section (A) above to offset penalties resulting from application of the NRC fuel rod models results in a LOCA peaking factor limit for Zion Units 1 and 2 of:

$$FQ = 2.20 - 0.03 = 2.17$$

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