SNUPPS

Standardized Nuclear Unit Power Plant System

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Executive Director

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SLNRC 84-0077 FILE: 0278
SUBJ: Revision in Diesel Generator Start Time

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Docket Nos. STN 50-482 and STN 50-483

References: 1. SLNRC 84-0069, dated 4/17/84: Same Subject
2. SLNRC 84-0071, dated 4/23/84: Same Subject

Dear Mr. Denton:

Reference 1 submitted information supporting the acceptability of an emergency diesel generator start time modification from 10 seconds to 12 seconds for the SNUPPS plants, Callaway Plant Unit No. 1 and Wolf Creek Generating Station Unit No. 1. Reference 2 provided additional information resulting from a comparison of the SNUPPS ECCS evaluation model to the more recent, 1981 evaluation model.

Based on a review of References 1 and 2, the NRC staff requested additional information regarding the burst blockage penalty in the 1981 evaluation model. The enclosure provides the evaluation of the burst blockage penalty for the SNUPPS plants and shows that this penalty, when combined with the benefits from using improved analytical and modelling techniques (Upper Head Injection plant technology in the 1981 ECCS evaluation model), gives a net peaking factor benefit of 0.16. This peaking factor benefit of 0.16 was translated as a benefit of 160°F in the Reference 1 evaluation and along with the 15°F benefit in peak clad temperature from the reduction in initial pellet temperature modelling change, support the net peak clad temperature margin of 200°F to the 50.46 criteria for the SNUPPS plants.

If there are any questions, please do not hesitate to call us.

Very truly yours,

[signature]

Nicholas A. Petrick

JOC/nld12a10
Attachment
cc: See Page 2

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Enclosure to SLNRC 84-0077

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 SNUPPS (SNP).

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 (Max. SI)

WESTINGHOUSE ECCS EVALUATION MODEL VERSION FEBRUARY 1978

CORE PEAKING FACTOR - 2.32

HOT ROD MAXIMUM TEMPERATURE CALUCLATED FOR THE BURST REGION OF THE CLAD - 1941.36^{o}F = PCT_B

ELEVATION - 6.0 feet

HOT ROD MAXIMUM TEMPERATURE CALCULATED FOR A NON-RUPTURED REGION OF THE CLAD - 2174.22^{o}F = PCT_N

ELEVATION - 7.5 Feet

CLAD STRAIN DURING BLOWDOWN AT THIS ELEVATION 2.43 Percent

MAXIMUM CLAD STRAIN AT THIS ELEVATION - 2.43 Percent

Maximum temperature for this non-burst node occurs when the core reflood rate is (LESS) than 1.0 inch per second and reflood heat transfer is based on the (STEAM COOLING) calculation.

AVERAGE HOT ASSEMBLY ROD BURST ELEVATION - 6.0 Feet

HOT ASSEMBLY BLOCKAGE CALCULATED - 46 Percent

I. 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 effects, (such as delta PCT 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:

$$\Delta PCT_1 = (0.027 + .03)\ (150^{o}F/.01) = 855^{o}F$$

Margin to the 2200°F limit is:

$$\Delta PCT_2 = 2200.^{o}F - PCT_B = \underline{258.64}\ ^{o}F$$

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

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

$$= (\underline{855} - \underline{258.69})\left(\frac{.01}{150}\right)$$

$$= \underline{.0398}$$ (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 sys... blowdown phase of the accid... 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:

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

$$= \left(\frac{20}{.01}\right)\ (\underline{2.43} - \underline{2.43})$$

$$= \underline{\quad 0 \quad}$$

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,

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

$$= 1.25\ (50 - \underline{46}) + 2.36\ (75-50)$$

$$= \underline{\quad 64 \quad}\ ^oF$$

.167.99
V... .87

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

$$\Delta PCT_5 = \Delta PCT_3 + \Delta PCT_4 = 64$$

Margin to the 2200°F limit is

$$\Delta PCT_6 = 2200^oF - PCT_N = 25.78$$

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

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

$$\Delta FQ_N = \underline{\ .0382\ }$$ 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_H,

or; $\Delta FQ_{PENALTY}$ = .0398

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 has recently been submitted to the NRC for review. Recognizing that review of that analysis is not yet complete and that the benefits associated with those model improvements can change for other plant designs, the NRC has established a credit that is acceptable for this interim period to help offset penalties resulting from application of the NRC fuel rod models. That credit for two, three and four loop plants is an increase in the LOCA peaking factor limit of 0.12, 0.15 and 0.20 respectively.

C. The peaking factor limit adjustment required to justify plant operation for this interim period is determined as the appropriate ΔFQ credit identified in section (B) above, minus the $\Delta FQ_{PENALTY}$ calculated in section (A) above (but not greater than zero).

FQ ADJUSTMENT = 0.20 - .0398 = 0. No Fq Penalty