POOR ORIGINAL

Westinghouse Electric Corporation

Water Reactor Divisions

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230

November 16, 1979

NS-TMA-2163

Mr. Darrell G. Eisenhut
Director, Division of
Operating Reactors
Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20014

Dear Mr. Eisenhut:

Letter NS-TMA-2147, dated November 2, 1979, responded to NRC concerns related to the fuel rod models used in the Westinghouse LOCA/ECCS evaluation model and potential non-compliance with the requirements of 10CFRPart 50. Table 1 of that letter included information on fuel rod heatup rate prior to burst. That information was based on our initial evaluation of the results of current LOCA analyses for Westinghouse plants with operating licenses. Subsequent to completion and transmittal of that letter, Westinghouse continued investigation of heatup rate calculations. As a result of that investigation, Westinghouse then developed a procedure to determine clad heatup rate prior to burst. That procedure keys on the calculated clad strain during the LOCA transient to establish a starting point, in time, to use in the heatup rate calculation. That procedure was presented to NRC personnel during a meeting on November 13, 1979, in Bethesda, and was accepted on an interim basis, as adequate with respect to Appendix K LOCA analyses. Table A shows the revision to the heatup rates previously given in Table 1 of Letter NS-TMA-2147.

Inspection of Table A shows heatup rates, in some cases, less than 25°F/sec.

In the current W ECCS Evaluation Model (Feb, '78) used for the above analyses, a fuel rod burst curve which represents burst conditions for heatup rates of 25°F/sec and larger was used. From Table A, since some cases have heatup rates less than 25°F/sec and burst conditions change for lower heatup rates, Westinghouse recognized that some of those analyses could be non-conservative with respect to the time of rod burst.

Therefore, W performed an evaluation of all operating plants licensed with the W ECCS Evaluation Model with respect to use of a heatup rate dependent burst model. The heatup rate dependent burst model currently used in the W Small Break Evaluation Model (documented in WCAP-8970-P-A "Westinghouse Emergency Core Cooling System Small Break, October 1975 Model" and approved by the NRC) was used in this evaluation.

1502 048 G007 S/1

7912050 509

C

The results of that evaluation, the status of each plant evaluated and justification of conclusions reached are as follows:

PLANT (1)	MODEL	FEB. '78
	FQ	2.31
	PCT	2172

A new analysis was performed using the appropriate heatup rate burst curve and water residing in the accumulator lines (not previously accounted for) was considered. The resulting PCT was 2135°F at an F_Q of 2.31.

Therefore, 10CFR50 criteria are satisfied.

PLANT (2)	MODEL	OCT. '75
	FQ	2.17
	PCT	2199

A LOCTA run was made using the Oct. 75 evaluation model with appropriate heatup rate burst curves for F_Q = 2.16, PCT = 2127 .

Use of Feb. '78 evaluation model, in particular the new accumulator discharge model, will compensate for the ΔFQ, shown above, to maintain 2200°F. (This is a burst node limited plant)

PLANTS (3) (4) (5) (6)

Since the heatup rate for the hot rod is greater than 25°F/second and the PCT does not occur during the steam cooling period, the current analysis for these plants remains valid.

PLANT (8)	MODEL	OCT. '75
	FQ	2.10
	PCT	2188°F

An Oct. '75 model LOCTA run was made using appropriate heatup rate burst curves. Results were: F_Q = 2.10, PCT = 2227.

Application of the "Dynamic Steam Cooling" modification of the Feb. '78 evaluation model will result in a 60°F reduction in PCT and the Feb. '78 accumulator discharge model will result in at least a 20°F reduction in PCT. Results of a Feb. '78 model analysis are expected to result in a PCT of approximately 2147°F at an F_Q of 2.10.

Therefore, 10CFR50 criteria will be satisfied and there is no safety concern.

PLANT (9)	MODEL	OCT. '75
	FQ	2.25
	PCT	2142

1502 049

POOR ORIGINAL

Based on the results of a calculation for plant #(14), the use of approximate heatup rate burst curves would result in a maximum PCT increase of 68°F. Thus, the estimated (maximum) PCT = 2142 + 68 = 2210°F at an F_Q = 2.25.

The benefits associated with the Feb. 78 accumulator discharge model and accounting for paint on containment heat sinks will result in a PCT reduction well in excess of 10°F.

Therefore, no safety problem exists.

PLANT (11)	MODEL	FEB. '78
	F_Q	1.90
	PCT	2124

A LOCTA calculation was performed using appropriate heatup rate burst curves. An F_Q of 1.89 resulted in a PCT of 2161°F.

Therefore, a peaking factor reduction of less than 0.01 is required for this plant to remain in compliance with 10CFR50.

PLANT (12)	MODEL	OCT. '7[illegible]
	F_Q	2.21
	PCT	2198

Based on analyses performed for plant #(15), a 15°F/second reduction in clad heatup rate impacts hot rod burst to effect PCT by +42°F. Extrapolating, a 17°F/second reduction in heatup rate results in a 48°F PCT increase. Use of the dynamic steam cooling calculation on the accumulator discharge model in the Feb. '78 ECCS evaluation model results in an estimated (60°F + 20°F) 80°F reduction in PCT.

Therefore, a Feb. '78 model analysis would result in a PCT of 2198+48-80=2166°F at F_Q of 2.21 and no safety problem exists.

PLANT (13)	MODEL	FEB. '78
	F_Q	2.05
	PCT	2172

A LOCTA calculation was done using appropriate heatup rate burst curves and the results were:

F_Q = 2.05, PCT = 2191°F

Therefore, no safety problem exists.

PLANT (14)	MODEL	FEB. '78
	F_Q	2.32
	PCT	2124

1502 050

POOR ORIGINAL

A LOCTA calculation was done using appropriate heatup rate burst curves and the results were:

$$F_Q = 2.32,\ PCT = 2192^oF$$

Therefore, no safety problem exists.

PLANT (15)	MODEL	FEB. '78
	F_Q	2.32
	PCT	2158

A LOCTA analysis was done using appropriate heatup rate burst curves and the results were:

$$F_Q = 2.32,\ PCT = 2200^oF$$

Therefore, no safety problem exists.

PLANTS (16) and (17)

The latest licensing analyses have been verified to use appropriate heatup rate burst curves and therefore remain valid.

PLANTS (18) and (19)

New LOCTA analyses were performed using appropriate heatup rate burst curves. The PCT was virtually unchanged. Therefore, no safety problem exists.

Based on the detailed information provided above, the Westinghouse Safety Review Committee concluded that two plants were found to require a reduction of 0.01 in allowable core peaking factor to maintain a PCT of 2200°F. Four other plants have current analyses to the October, 1975 version of the Westinghouse model and may require a peaking factor reduction. However, we believe that reanalyses with the most current Westinghouse LOCA/ECCS evaluation model (February, 1978) would show that no changes are necessary. That is, we believe margins available in this model will more than offset any effect associated with the change in the fuel clad burst curve. A copy of the NRC notification letter (NS-TMA-2158) regarding this issue is attached.

The above information was also presented to the NRC Staff at the November 13, 1979 meeting.

Following the November 1, 1979 meeting, Westinghouse has again reviewed the ORNL data quoted as a basis for NRC concern regarding adequacy of the W Appendix K blockage model. Comparison of individual rod burst strains from ORNL data to the corresponding Westinghouse data which has used as a basis for our blockage model indicates the ORNL data is in excellent agreement with the W data. Since the axial distribution of the burst strains in the ORNL multi rod burst test has been shown by ORNL to conform to local temperature distributions in the specific heating rods used in the tests, conclusion as to the applicability of the axial distribution of bursts (which is the parameter that relates individual burst strain to flow blockage) cannot validly be made. Nevertheless, the blockages measured from the ORNL tests are similar to those calculated by the Westinghouse model, which has been approved by NRC, when due consideration is made in translating blockages measured in 4X4 bundles to blockages applicable to 15X15 or 17X17 rod fuel assemblies using accepted statistical techniques. Thus, we believe no immediate action is appropriate with respect to reanalysis of plants using the proposed NRC blockage model pending detailed review of the proposed model.

As a result of further investigation and evaluation, the following can be concluded:

1) A modification to the W model to account for the heatup rate dependence is necessary for compliance to Appendix K.
2) The impact of this modification is relatively small, effecting only two operating plants in terms of requiring peaking factor adjustments to meet the criteria of 10CFR50.46. The affected utilities and the NRC have been adequately informed.
3) Comparison of the Westinghouse data and ORNL data shows excellent agreement and the current Westinghouse model, in the range of interest, is still appropriate.

It is therefore concluded that no safety problem for Westinghouse plants has been identified and all plants are in conformance with NRC regulations since the burst temperature modifications (1 and 2 above) are accounted for.

Very truly yours,

T. M. Anderson, Manager
Nuclear Safety Department

1502 052

TABLE A

REVISION TO HEATUP RATES TRANSMITTED
IN LETTER NS-TMA-2147

CASE	HEATUP RATE (°F/SEC) HOT ROD	AUG OR ADJ ROD
1)	8.5	10.9
2)	20.3	13.1
3)	25.6	18.0
4)	25.0	15.4
5)	31.5	19.4
6)	27.4	23.8
7)	(Not Westinghouse Fuel)	
8)	19.1	7.4
9)	12.3	12.0
10)	(Not Westinghouse Fuel)	
11)	6.2	11.3
12)	8.0	11.4
13)	18.3	16.1
14)	9.3	14.3
15)	8.2	13.8
16)	39.6	23.7
17)	43.2	26.7
18)	22.7	17.6
19)	26.5	16.7

Westinghouse Electric Corporation

Water Reactor Divisions

Box 355
Pittsburgh Pennsylvania 15230

November 16, 1979

NS-TMA-2158

Mr. Victor Stello
Director, Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
East West Towers Building
4350 East West Highway
Bethesda, MD 20014

Dear Mr. Stello:

Subject: ECCS Evaluation Model

This is to confirm our telephone conversation with Mr. Frank Nolan on Friday afternoon, November 2, 1979. In that conversation we reported a non-conservative feature in Westinghouse large break ECCS evaluation models.

The Nuclear Regulatory Commission staff met November 1, 1979, with representatives of reactor vendors and nuclear fuel suppliers -- Combustion Engineering Inc., Exxon Corporation, General Electric Company, Westinghouse Electric Corporation and Babcock and Wilcox Company. Utilities which operate nuclear power plants were informed by NRC.

The purpose of the meeting was to discuss the staff's ongoing evaluation of the results of tests on electrically-heated fuel assemblies conducted at the Oak Ridge (Tennessee) National Laboratory. NRC indicated that emergency core cooling system analytical codes currently used to evaluate the effects of postulated loss-of-coolant accidents (LOCA) might not be in compliance with NRC regulations. The portion of the codes in question deal with the effects of fuel clad swelling and rupture and blockage of cooling water.

Subsequent to the meeting, Westinghouse performed a detailed evaluation of the most recent analyses for operating plants and on November 2, 1979, Westinghouse confirmed, in writing, that the impact of the information presented by the NRC has negligible impact on the LOCA analysis results of the plants licensed with the Westinghouse LOCA/ECCS evaluation model. The NRC staff has concurred with this conclusion.

1502 054

dupe 7912040357

However, as a result of that detailed evaluation, Westinghouse has now recognized that a non-conservative feature could exist in the Appendix K LOCA analysis with respect to the portion of the calculation related to fuel rod burst. The potential non-conservative feature of Westinghouse large break ECCS evaluation models is as follows. The models use a curve which represents fuel clad burst conditions for clad heatup rates of 25°F/second and greater. The evaluation discussed revealed that heatup rates could be less than 25°F/second. During the LOCA transient, the fuel clad burst curve establishes the time of clad burst and (since the clad temperature and the pressure differential across the clad are changing throughout the LOCA transient) the post-burst conditions of the clad. The fuel clad burst curve is dependent on the clad heatup rate prior to burst and a reduction in heatup rate causes earlier clad burst. A shift in clad burst time can affect the peak clad temperature (PCT) calculated for the LOCA transient.

Therefore, in order to more fully evaluate this effect, the clad heatup rate prior to burst was determined from the most recent LOCA analyses for those plants licensed with the Westinghouse LOCA/ECCS evaluation model. Plants having heatup rates less than 25°F/second were reanalysed to ascertain the effect on peak clad temperature. Two plants (Turkey Point Units 3 and 4) were found to require a reduction of 0.01 in F_Q to maintain a Peak Clad Temperature (PCT) of 2200°F. A third plant, Indian Point Unit No. 2, was not expected to require any F_Q reduction, considering the present PCT and available sensitivity studies. Analyses, underway at the time of our telephone conversation, have now been completed and confirm this.

Four other plants, currently not operating (Trojan, North Anna Unit 1, Indian Point Unit 3 and D. C. Cook Unit 2) have current analyses to the October 1975 Westinghouse model and on that basis might require a reduction in F_Q. However, we believe that reanalyses with the most recently approved Westinghouse LOCA/ECCS evaluation model (February 1978) would show that no changes are necessary. That is, we believe margins available in this model will more than offset any effect associated with the change in the fuel clad burst curve.

We have advised the affected utilities of this unreviewed safety question. As part of this overall evaluation, we are examining plants under construction and will report as appropriate. Please feel free to contact Dr. Vincent Esposito (412-373-4059) if you should have any questions.

Very truly yours,

T. M. Anderson, Manager
Nuclear Safety Department

/wpc

1502 055