EXXON NUCLEAR COMPANY, INC.

2101 HORN RAPIDS ROAD, PO BOX 130, RICHLAND, WA 99352
(509) 375-8100 TELEX: 15-2878

September 30, 1985

Mr. John B. Martin
Regional Administrator, Region V
United States Nuclear Regulatory Commission
1450 Maria Lane, Suite 210
Walnut Creek, CA 94596

SUBJECT: Notification of Error in LOCA Analyses

Dear Mr. Martin:

As reported in a telephone conversation on September 30, 1985 between Mr. Yuhas of Region V and me, an error was discovered in the 10 CFR 50.46 loss of coolant accident (LOCA) analyses performed by Exxon Nuclear for the H.B. Robinson Unit 2 and D.C. Cook Unit 1 reactors. The error was an input error in the TOODEE2 code which is used to calculate fuel rod heatup. The error resulted in the rod decay heat power being too low which caused the calculated peak cladding temperature to be underpredicted. Attached is a detailed description of the effect of error for each unit and the resulting underprediction in the peak cladding temperatures.

All of the pressurized water reactors for which Exxon Nuclear provides LOCA analyses have been reviewed. The error was verified to have occurred in the analyses for only these two plants. For D.C. Cook Unit 1, the calculation was rerun with the error corrected and using more realistic values of the pellet density and internal pressure. This analysis was in compliance with the requirements of 10 CFR 50.46.

For H.B. Robinson Unit 2, the calculated PCTs with the error corrected were above 2200°F. A reduction in F_Q which corresponds to the underestimate of the rod power was necessary to maintain compliance with the 10 CFR 50.46 requirements.

As required by the Exxon Nuclear procedures, a Hazards Review Board was convened on September 28, 1985 when the effect of the errors had been determined. The Board concluded that the affected utilities should be notified, that they should in turn notify the NRC, and that H.B. Robinson Unit 2 should immediately reduce the allowed F_Q as indicated in the attachment. Based on subsequent conversations with the affected utilities, these recommendations have been followed.

This letter provides the written notification using the procedures given in 10 CFR 21.21(b). If there are questions, or if further information is needed, please contact me.

Sincerely,

C. Malody

C. Malody, Manager
Corporate Licensing

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cc: Mr. R. DeYoung (3 copies) (D/OIE USNRC)
Mr. J. Bell (AEPSC)
Mr. T. Dresser (CP&L)

Attachment

Error in LOCA-ECCS Analysis for H.B. Robinson Unit 2 and D.C. Cook Unit 1

Ref.:

(1) XN-NF-84-72, "H.B. Robinson Unit 2 Large Break LOCA-ECCS Analysis with Increased Enthalpy Rise Factor," Exxon Nuclear Company, July 1984

(2) XN-NF-84-72, Supp. 1, "H.B. Robinson Unit 2 Large Break LOCA-ECCS Analysis with Increased Enthalpy Rise Factor: Break Spectrum Analysis," Exxon Nuclear Company, August 1984 .

(3) XN-NF-84-72, Supp. 2, "H.B. Robinson Unit 2 Large Break LOCA-ECCS Analysis with Increased Enthalpy Rise Factor: K(Z) Curve," Exxon Nuclear Company, August 1984

(4) XN-NF-83-61, "D.C. Cook Unit 1 LOCA-ECCS Analysis for Extended Exposure," Exxon Nuclear Company, August 1983

(5) Letter, G.F. Owsley, Manager, Reload Licensing Liaison (ENC) to Richard DeYoung, Director of Inspection and Enforcement (USNRC), dated March 22, 1985 (GFO:85:010)

The LOCA-ECCS analyses for the reactors H.B. Robinson Unit 2 and D.C. Cook Unit 1 reported in the above references have been found to contain an error. The error was in the input to the code TOODEE2. The code TOODEE2 calculates the thermal response (heatup) of the hot fuel rod following the end of the blowdown transient until the core temperature transient is terminated. The fuel rods in the analyses were modeled with eight radial rings in the fuel pellet. The error consisted of the assignment of a relative decay heat power density of 0.0 in the outer ring of the fuel pellet and resulted in calculated peak clad temperatures which were too low.

H. B. Robinson Unit 2

A summary of the peak clad temperatures for the H.B. Robinson Unit 2 analysis, reported in References 1, 2 and 3, and of the calculated peak clad temperatures with the error corrected is presented in the attached Table 1. The first three cases in Table 1 were originally performed as part of an exposure sensitivity study, and the final two cases were performed to define the axial power peaking factor dependence (K(Z) curve). As can be seen from the table, three of these cases result in peak clad temperatures greater than 2200°F and thus exceed the 10 CFR 50.46 criteria.

An analysis was performed to determine an F_Q which would result in peak clad temperatures less than 2200°F. This required a reduction in F_Q of 8% which was achieved by a reduction of the hot rod power in the TOODEE2 code of 8%. This is a conservative calculation because the F_Q in the blowdown portion of the transient has not been reduced. The initial temperatures at the start of the TOODEE2 (heatup) calculation are therefore conservative with respect to the F_Q in the TOODEE2 calculation. A reduction of the F_Q in the blowdown portion of the transient would result in the calculation of even lower temperatures. The results of these calculations are summarized in Table 2.

The F_Q limits for H.B. Robinson Unit 2 which will result in LOCA-ECCS calculational results in conformance with the 10 CFR 50.46 criteria are shown in Table 3. The limits are divided into two exposure ranges consistent with the analysis, 0 to 9 MWD/kg and 9 MWD/kg to 49 MWD/kg.

D. C. Cook Unit 1

The error in the D.C. Cook Unit 1 analysis (References 4 and 5) occurred only in the calculation for the case at 48 MWD/kg. The cases at lower exposures do not contain the error. The calculation in error was rerun with the error corrected and more realistic values for the pellet density and internal rod pressure. The reanalysis resulted in a peak clad temperature change from 1827°F to 2189°F, which is still in compliance with 10 CFR 50.46. This revised calculation is very conservative in that the stored energy used in the calculation is the peak stored energy over the range 0 to 48 MWD/kg rather than a lower value of stored energy that would be appropriate for the 48 MWD/kg exposure for this case. Additionally, it is our understanding that the ENC-designed fuel in D.C. Cook Unit 1 is not in the exposure range for which this calculation is applicable.

Table 1 H.B. Robinson Unit 2 Error in TOODEE2 Input; Rod Radial Power Distribution

Case Description (Exposure/Power Shape)	Previous Peak Clad Temperature (°F)	Corrected Peak Clad Temperature (°F)
BOL/Cosine	2042	> 2200
9 MWD/kg/Cosine	1815	1923
EOL/Cosine	1785	1888
BOL/Top Peaked	2197	> 2200
9 MWD/kg/Top Peaked	2183	> 2200

Table 2 H.B. Robinson Unit 2 Reanalysis with F_Q*.92 in TOODEE2 Calculation

Case Description (Exposure/Power Shape)	Peak Clad Temperature (^oF)
BOL/Cosine	2064
BOL/Top Peaked	2195
9 MWD/kg/Top Peaked	2187

Table 3 H.B. Robinson Unit 2 LOCA-ECCS Limits

0 to 9 MWD/kg Hot Rod Average Exposure			9 to 49 MWD/kg Hot Rod Average Exposure		
X/L	$F_Q(Z)$	K(Z)	X/L	$F_Q(Z)$	K(Z)
0.000	2.130	1.000	0.000	2.320	1.000
0.500	2.130	1.000	0.500	2.320	1.000
0.916	1.690	0.793	0.916	1.726	0.744
1.000	0.835	0.392	1.000	0.835	0.360

Attachment 2 to AEP:NRC:0940B

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EXXON NUCLEAR COMPANY, INC.

2101 HORN RAPIDS ROAD, PO BOX 130, RICHLAND, WA 99352
(509) 375-8100 TELEX: 15-2878

September 30, 1985
JSH:044:85

Mr. Joseph L. Bell
Project Manager, D.C. Cook Unit 1
Indiana & Michigan Electric Company
c/o American Electric Power Service Corp.
One Riverside Plaza
Columbus, OH 43216-6631

SUBJECT: Error in LOCA/ECCS Analysis for D.C. Cook Unit 1

Ref.: (1) XN-NF-83-61, "D.C. Cook Unit 1 LOCA-ECCS Analysis for Extended Exposure," Exxon Nuclear Company, August 1983

(2) Letter, G.F. Owsley, Manager, Reload Licensing Liaison (ENC) to Richard DeYoung, Director of Inspection and Enforcement (USNRC), dated March 22, 1985 (GFO:85:010)

Dear Mr. Bell:

As discussed with Mr. George John (AEP) on September 28, 1985, the LOCA-ECCS analysis for D.C. Cook Unit 1 reported in References 1 and 2 contains an error. The error was in the input to the code TOODEE2. The code TOODEE2 calculates the thermal response (heatup) of the hot fuel rod following the end of the blowdown transient until the core temperature transient is terminated. The fuel rod in the analysis was modeled with eight radial rings in the fuel pellet. The error consisted of the assignment of a relative decay heat power density of 0.0 in the outer ring of the fuel pellet. This resulted in a calculated peak clad temperature which was too low. The error occurred only in the calculation for the case at 48 MWD/kg.

The calculation in error was rerun with the error corrected and with the fuel rod pellet density increased and the internal rod pressure decreased to values appropriate for 48 MWD/kg. This calculation resulted in a peak clad temperature of 2189°F in compliance with 10 CFR 50.46. These calculations are summarized in Table 1. This calculation is still very conservative in that the stored energy in the calculation is the peak stored energy over the range 0 to 48 MWD/kg rather than a lower value of stored energy that would be appropriate for the 48 MWD/kg exposure for this case. Additionally, it is our

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understanding that the ENC fuel in D.C. Cook Unit 1 is not in the exposure range for which this calculation is applicable.

Sincerely,

J. S. Holm

J. S. Holm, Manager
PWR Safety Analysis

gf

Attachment

cc: Mr. J. M. Cleveland (AEP)
Mr. M. P. Alexich (AEP)
Mr. G. John (AEP)
Mr. H. G. Shaw (ENC)
Mr. R. A. Copeland (ENC)
Mr. R. L. Heiks (ENC)

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ATTN. J. L. Bell

Table 1 D.C. Cook Unit 1 Error in TOODEE2 Input;
Rod Radial Power Distribution

Case Description	Peak Clad Temperature (°F)
Previous Result*	1827
Corrected Result with increased pellet density and reduced fuel rod pressure	2189

*The previous result was for a cosine power distribution at 48.0 MWD/kg exposure, F_Q=1.82, reported in References 1 and 2.