EXXON NUCLEAR COMPANY, Inc.

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January 3, 1983

JCC:001:83

Mr. L. E. Phillips
Core Performance Branch
Division of Systems Integration
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: XN-NF-621(P), Revision 1, "Exxon Nuclear DNB Correlation for PWR Fuel Designs," April 1982

Ref.: (1) Letter, J. C. Chandler (ENC) to J. J. Holonich (NRC), same subject, dated December 9, 1982; JCC:120:82

(2) Letter, J. C. Chandler (ENC) to L. E. Phillips (NRC), same subject, dated December 16, 1982; JCC:127:82

(3) Letter, J. C. Chandler (ENC) to L. E. Phillips (NRC), same subject, dated December 23, 1982; JCC:130:82

Dear Mr. Phillips:

The reference letters describe the discussions between your staff and the ENC technical staff regarding application of our XNB critical heat flux correlation to PWR fuel designs. In the reference (3) letter, we proposed an interim solution for 17x17 and 16x16 fuel applications based on consideration of only a restricted number of test sections in the XNB data base. That proposed solution was judged by the NRC to be inadequate because the restricted data base did not contain asymmetric axial power distributions. Following discussions with Messrs. Hsii and Schwenk of your staff, we have determined that the best course of action is to remove the ENC-1 and ENC-2 test sections from the data base and proceed with generic resolution of the XNB issue.

We judge test section ENC-1 to be non-representative of monitored reactor conditions because the data were obtained using grid spacers designed to minimize the effect of the spacers on fluid flow (i.e., minimum grid). We judge test section ENC-2 to be atypical of actual reactor conditions because the data were based on a small, biased sampling of data using both uniform axial and uniform radial heat flux distributions concurrently. Neither of these sets of conditions exists or is expected to exist in an operating reactor. The sampling bias is present in both test sections because the data include only a small fraction of the range of conditions over which the correlation is valid. Both of these test sections should be removed from the data base becaues they do not adequately represent operating reactor conditions.

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Considering the entire XNB data base, we calculate a 95/95 minimum DNBR limit of 1.17. This value considers both variations within individual data sets and variations between the data sets. Based on the statistical conclusions presented in your consultant's final report, we also calculate a 95/95 minimum DNBR limit of 1.17. A summary of our statistical evaluation is given in the attached Table 1. Based on the range of test conditions reported in Table 3.1 of the subject report, the range of applicability of the XNB correlation is as given in the attached Table 2. We propose that the 95/95 minimum DNBR limit be established at a value of 1.17.

Since this proposed resolution covers the entire proposed range of applicability, we feel that its acceptance would constitute final resolution of the issue as mentioned in the final paragraph of the reference (3) letter. If you have any questions, please feel free to call, telephone (509) 375-8639.

Sincerely,

J.C. Chandler

J. C. Chandler
Reload Fuel Licensing

JCC:gf
Attachments
As noted

CC: Mr. J. J. Holonich (USNRC)
Mr. Y. Hsii (USNRC)
Mr. G. A. Schwenk (USNRC)

Table 1

STATISTICAL SUMMARY

All Test Sections

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TEST SECTION	NUMBER	MEAN	STANDARD DEVIATION
E3	73	0.9443	0.102980
E4	80	0.9851	0.119660
E5	59	0.9110	0.084800
CE47	96	1.0285	0.074140
CE59	89	1.0359	0.071860
WH64	53	0.9502	0.067750
WH62	53	0.9920	0.084500
ENC6	62	0.9952	0.074980
R2	28	0.9761	0.111880
R4	26	0.9330	0.084390
R7	11	0.9709	0.104330
R8	32	1.0017	0.098750
	662	0.98396	0.095648

WITH 95% CONFIDENCE AT LEAST 95% OF THE DNBR (PREDICTED TO MEASURED DNB HEAT FLUX) VALUES ARE LESS THAN 1.163 FOR ALL THE DATA ANALYZED.

Table 1

STATISTICAL SUMMARY

GROUP 1

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TEST SECTION	NUMBER	MEAN	STANDARD DEVIATION
CE47	96	1.0285	0.074140
CE59	89	1.0359	0.071860
WH62	53	0.9920	0.084500
ENC6	62	0.9952	0.074980
ROSAL2	28	0.9761	0.111880
ROSAL7	11	0.9709	0.104330
ROSAL8	32	1.0017	0.098750
	371	1.0115	0.08425

WITH 95% CONFIDENCE AT LEAST 95% OF THE DNBR (PREDICTED TO MEASURED DNB HEAT FLUX) VALUES ARE LESS THAN 1.169 FOR ALL THE DATA ANALYZED.

Table 1

STATISTICAL SUMMARY

Group 2

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TEST SECTION	NUMBER	MEAN	STANDARD DEVIATION
WH64	53	0.9502	0.067750
R4	26	0.9330	0.084390
E3	73	0.9443	0.102980
E4	80	0.9851	0.119660
	252	0.9585	0.102128

WITH 95% CONFIDENCE AT LEAST 95% OF THE DNBR (PREDICTED TO MEASURED DNB HEAT FLUX) VALUES ARE LESS THAN 1.150 FOR ALL THE DATA ANALYZED.

Table 1

STATISTICAL SUMMARY

Group 3

TEST SECTION	NUMER	MEAN	STANDARD DEVIATION
ENC-5	59	0.911	0.0848
Overall	59	0.911	0.0848

With 95% confidence at least 95% of the DNBR (predicted to measured DNB heat flux) values are less than 1.114 for all the data analyzed.

Table 2 Range of Applicability

Pressure (psia)	1395-2425
Inlet Avg. Mass Velocity ($Mlb/hr-ft^2$)	.92 - 3.04
Local enthalpy (BTU/lb)	594.85 - 821.24
X	-.2 - +.3
Heated length (in)	144 - 168
Spacer span (in)	14.3 - 22
Inlet subcooling (BTU/lb)	37.2 - 336.34
Vendor	ENC, CE, Westinghouse
Grid Design	Non-vaned, vaned
Axial profile	Chopped cosine, uniform, upskew
Hydraulic Diameter (nominal channel) (inch)	0.463 - 0.510