Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

May 22, 1992

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Dresden Nuclear Power Station Units 2 and 3
Quad Cities Nuclear Power Station Units 1 and 2
LaSalle County Nuclear Power Station Units 1 and 2
Topical Report for Neutronics Methods for BWR Reload Design
NRC Docket Nos. 50-237/249, 50-254/265 and 50-373/374

References:

1) P. L. Piet (CECo) letter to T. E. Murley (NRC), dated December 31, 1991, submitting CECo Topical Report NFSR-0091.

2) P. L. Piet (CECo) letter to T. E. Murley (NRC), dated March 24, 1992, submitting CECo Topical Report NFSR-0091 Supplement 1

Dear Dr. Murley:

This letter provides information which supplements the referenced submittals concerning CECo neutronics methods for BWRs.

The Reference 1 letter submitted for NRC Staff review and approval the licensing topical report titled "Commonwealth Edison Company Topical Report - Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", NFSR-0091, Revision 0. The Reference 2 letter submitted for NRC staff review and approval the licensing topical report titled "Commonwealth Edison Company Topical Report - Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods - Nuclear Licensing Analyses", NFSR-0091, Supplement 1, Revision 0. The Topical Report and Supplement summarize the nuclear analysis and neutronics licensing methods employed by Commonwealth Edison Company (CECo), based on Siemens Nuclear Power Corporation (SNP) approved methodology, in support of reload nuclear design for Dresden, Quad Cities, and LaSalle County Stations.

ZNLD/1810/4

A001

MICROBURN ERROR ASSESSMENT

The references also indicated that after completion of the Reference 1 Topical Report, CECo discovered a minor error in the MICROBURN computer code obtained from SNP. The impact of this error, which involved the code's manipulation of the samarium number density array to reflect fuel shuffling, occurs near beginning of cycle (BOC) only. This error has been assessed by SNP. That assessment was provided in Reference 1 and has been shown to affect hot and cold eigenvalues by approximately 0.0005 ΔK or less.

Because the impact on comparisons to plant data (Reference 1 information) is very slight and well within the uncertainty of the calculations for hot and cold conditions, and there is no impact on CECo comparisons to SNP results (since both CECo and SNP results are equally affected in Reference 2), CECo did not repeat the entire benchmark. No correction for this error has been incorporated in the referenced topical reports.

CECo did indicate, however, that sample cases incorporating correction of the samarium shuffling error would be reperformed and provided by mid-May 1992 to demonstrate the small impact consistent with SNP's assessment. These sample cases are provided herein as Attachment 1. The attachment provides detailed hot critical eigenvalue results, cold critical eigenvalue results, and Traversing Incore Probe (TIP) calculated versus measured results for two cycles of Dresden Unit 2. Comparisons are provided for results that incorporate correction of the error and results that contain the error. The differences are negligible as expected.

LASALLE BENCHMARK COMPARISONS

Additionally, CECo has employed the SNP methodology to perform benchmark calculations on LaSalle County Unit 2. Hot critical eigenvalue calculations, cold critical eigenvalue calculations, and predicted to measured TIP comparisons were performed for cycles one through four. The results of those benchmarks are incorporated in the enclosed CECo topical report supplement titled "Commonwealth Edison Company Topical - Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods - LaSalle County Unit 2" (NFSR-0091, Supplement 2, Revision 0). This document is included herein for NRC staff review and approval as Attachment 2 to provide further justification for CECo's requested application of the SNP methodology to all its BWR's. These calculations had been substantially completed prior to CECo receiving the version of MICROBURN from SNP that corrected the samarium shuffling error. Based on the negligible impact of this error as demonstrated in Attachment 1, CECo did not repeat the LaSalle County benchmark.

APPLICATION PLANS

Restating information previously provided in Reference 1, CECo has two fuel vendors for its three BWR stations: SNP is the fuel supplier for Dresden Station; and General Electric (GE) is the fuel supplier for Quad Cities and LaSalle County Stations. Due to the differences between the SNP and GE methodologies with respect to the Critical Power correlation and the associated uncertainties, CECo is currently not planning on using the SNP methods described in the Reference 2 topical report for neutronic licensing calculations for non-SNP supplied units (currently Quad Cities and LaSalle County Stations which have GE-supplied fuel). However, CECo may utilize the SNP steady-state neutronic methods for Quad Cities and LaSalle County fuel management and operational support analyses as outlined in Table 1.3-1 of the Reference 1 topical report. CECo plans to apply these NRC approved SNP methods and computer codes to BWR reload licensing analyses beginning with Dresden Unit 3 Cycle 14. To support this effort, CECo has previously requested approval of the topical report and supplements by December 1992. Previous discussions with your staff have indicated CECo's schedule can be supported.

Please contact this office should further information be required.

Respectfully,

Peter L. Piet
Nuclear Licensing Administrator

Attachments:

1) Evaluation of Effects of Improper Shuffling of Samarium Number Density Arrays in MICROBURN-B

2) CECo Topical Report "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods - LaSalle County Unit 2", NFSR-0091, Supplement 2, Revision 0, May 1992.

cc: A. B. Davis - Regional Administrator, Region III
B. L. Siegel - Dresden/LaSalle Project Manager, NRR
L. N. Olshan - Quad Cities Project Manager, NRR
R. C. Jones - Reactor Systems Branch Chief, NRR (w/2 copies of Att.)
W. G. Rogers - Senior Resident Inspector, Dresden
T. Taylor - Senior Resident Inspector, Quad Cities
D. E. Hills - Senior Resident Inspector, LaSalle County

ZNLD/1810/6

ATTACHMENT 1

EVALUATION OF EFFECTS OF IMPROPER SHUFFLING OF

SAMARIUM NUMBER DENSITY ARRAYS IN MICROBURN-B

EVALUATION OF EFFECTS OF IMPROPER SHUFFLING OF SAMARIUM NUMBER DENSITY ARRAYS IN MICROBURN-B

BACKGROUND

Commonwealth Edison Company (CECo) has actively focused on assuming the responsibility for performing reload design activities. In support of performing reload nuclear design analyses for Dresden, Quad Cities, and LaSalle County Stations, a CECo Topical Report titled, "Commonwealth Edison Company Topical Report - Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", NFSR-0091, Revision 0, dated December 1991 was submitted for NRC staff review and approval (see Reference).

The Reference also indicated that after completion of the NFSR-0091 Topical Report, CECo discovered a minor error in the MICROBURN code obtained from Siemens Nuclear Power Corporation (SNP). The impact of this error, which involves the manipulation of the samarium number density array to reflect fuel shuffling, occurs near beginning of cycle (BOC) only. The error was assessed by SNP and was shown to affect hot and cold eigenvalues by approximately 0.0005 Δk or less. Due to the small effect and the timing of the error discovery, no correction for this code deficiency had been incorporated in the referenced Topical Report.

Because the impact on comparisons to plant data were very slight and well within the uncertainty of the calculations for both hot and cold conditions, CECo indicated in the Reference that the entire benchmark would not be repeated. CECo, however, committed to repeating the analysis of selected cases. These cases were re-performed and are provided herein to demonstrate the small impact of the error, which is consistent with SNP's assessment.

METHOD OF EVALUATION

To evaluate the effects of improper shuffling of samarium number density arrays in MICROBURN-B, the hot critical eigenvalue results, cold critical eigenvalue results, and predicted to measured Traversing Incore Probe (TIP) results for Dresden Unit 2 Cycles 11 and 12 were re-evaluated with a corrected version of MICROBURN-B. To ensure there were no residual effects of improper samarium shuffling in this re-evaluation, Dresden Unit 2 Cycles 6 through 10 were re-depleted with the corrected version of MICROBURN-B prior to re-calculating these parameters for the corrected Cycles 11 and 12.

RESULTS

Comparison of the hot critical eigenvalue results, cold critical eigenvalue results, and TIP results from the referenced Topical Report and those same results obtained from the corrected version of MICROBURN-B show differences to be very slight and well within the uncertainty of the calculations for both hot and cold conditions. These differences obtained by CECo are consistent with SNP's assessment provided in the Reference.

Tables 1 and 2, herein, document the hot critical eigenvalues as a function of cycle exposure for Dresden Unit 2 Cycles 11 and 12, respectively. These Tables provide the original results upon which NFSR-0091 is based and the corresponding results which reflect correction of the samarium shuffling error. Tables 1 and 2 indicate the samarium shuffling error has a negligibly small impact on the exposure dependent hot critical eigenvalue results, with essentially no difference in the mean and standard deviations for the cycles.

The cold critical eigenvalues for Dresden Unit 2 Cycles 11 and 12 are documented in Table 3. The original data from NFSR-0091 is tabulated along with the corresponding data generated with the version of MICROBURN-B which corrects the samarium number density shuffling error. Again, there is a negligible impact on the cold critical K-effective results as a consequence of the samarium shuffling error.

Table 4 documents the TIP results for Dresden Unit 2 Cycles 11 and 12. The Table provides the original radial and nodal results from NFSR-0091 and the results which reflect correction of the samarium shuffling error. This Table indicates a very minor impact on the TIP results, with essentially no difference in the means for Cycles 11 and 12 combined.

SUMMARY

MICROBURN's improper shuffling of samarium number density arrays has been evaluated using Dresden Unit 2 Cycles 11 and 12. The hot critical eigenvalue results, cold critical eigenvalue results, and predicted to measured TIP results from the Commonwealth Edison Topical Report - "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", NFSR-0091, Revision 0 are negligibly affected when these cycles are re-evaluated with proper shuffling of the samarium number density arrays. Based on these results and those of SNP, the conclusion of negligible impact on Cycles 11 and 12 can be extended to all units and cycles evaluated as part of the CECo benchmark process. Therefore, all results and uncertainties presented within NFSR-0091 remain valid.

REFERENCE

December 31, 1991, letter from P. L. Piet to T. E. Murley transmitting CECo Topical Report NFSR-0091.

Table 1

Dresden Unit 2 Cycle 11

Hot Critical Eigenvalue Versus Cycle Exposure

Cycle Exposure (GWD/MT)	NFSR-0091 Keff with Improper Sm Shuffling	Keff with Corrected Sm Shuffling
0.11	1.0034	1.0033
0.42	1.0042	1.0041
0.57	1.0055	1.0055
0.93	1.0058	1.0058
1.19	1.0044	1.0044
1.52	1.0045	1.0045
1.74	1.0049	1.0049
1.82	1.0052	1.0052
1.92	1.0053	1.0053
2.25	1.0047	1.0047
2.32	1.0047	1.0047
2.40	1.0047	1.0047
2.73	1.0042	1.0042
2.89	1.0035	1.0036
2.98	1.0033	1.0033
3.16	1.0027	1.0028
3.32	1.0042	1.0040
3.75	1.0023	1.0023
3.81	1.0037	1.0037
3.94	1.0025	1.0025
4.20	1.0027	1.0027
4.41	1.0031	1.0031
4.57	1.0035	1.0035
4.82	1.0040	1.0041
5.00	1.0040	1.0040
5.26	1.0048	1.0048
5.44	1.0046	1.0046
5.71	1.0053	1.0052
6.15	1.0058	1.0057
6.23	1.0052	1.0050
6.39	1.0054	1.0054
6.52	1.0056	1.0056
6.92	1.0031	1.0031
7.20	1.0040	1.0040
7.40	1.0053	1.0052
7.92	1.0066	1.0066
8.02	1.0070	1.0071
8.23	1.0079	1.0079
8.46	1.0082	1.0083
Mean	1.00462	1.00460
Standard deviation	0.00137	0.00137

ASP:cs
ZBRDLE:21:3

Table 2

Dresden Unit 2 Cycle 12

Hot Critical Eigenvalue Versus Cycle Exposure

Cycle Exposure (GWD/MT)	NFSR-0091 Keff with Improper Sm Shuffling	Keff with Corrected Sm Shuffling
0.13	1.0093	1.0091
0.30	1.0090	1.0089
0.45	1.0088	1.0088
0.60	1.0088	1.0088
0.84	1.0085	1.0085
1.02	1.0084	1.0084
1.45	1.0077	1.0077
1.56	1.0080	1.0080
1.82	1.0066	1.0065
2.36	1.0025	1.0022
2.71	1.0022	1.0022
2.81	1.0047	1.0045
3.08	1.0062	1.0062
3.17	1.0064	1.0065
3.34	1.0068	1.0068
3.52	1.0068	1.0067
3.63	1.0066	1.0066
3.87	1.0063	1.0063
3.99	1.0066	1.0068
4.15	1.0068	1.0069
4.26	1.0069	1.0069
4.32	1.0071	1.0072
4.44	1.0064	1.0065
4.73	1.0059	1.0059
4.86	1.0053	1.0053
5.04	1.0074	1.0075
5.10	1.0074	1.0073
5.70	1.0074	1.0074
5.91	1.0077	1.0078
6.34	1.0092	1.0093
6.59	1.0088	1.0090
6.73	1.0097	1.0097
6.96	1.0100	1.0101
7.09	1.0087	1.0090
7.23	1.0097	1.0098
7.46	1.0099	1.0100
7.70	1.0100	1.0099
7.82	1.0099	1.0099
8.01	1.0096	1.0093
8.75	1.0096	1.0095
9.01	1.0094	1.0094
9.25	1.0099	1.0099
9.38	1.0099	1.0098
9.62	1.0102	1.0102
9.78	1.0106	1.0105
Mean	1.00785	1.00785
Standard deviation	0.00193	0.00194

ASP:cs
ZBRDLE:21:4

Table 3

Dresden Unit 2 Cycles 11 and 12

Cold Critical Eigenvalue Versus Cycle Exposure

Dresden Unit 2 Cycle	Cycle Exposure (GWD/MT)	NFSR-0091 Keff with Improper Sm Shuffling	Keff with Corrected Sm Shuffling
11	0.00	1.0080	1.0077
11	0.00	1.0094	1.0091
11	1.59	1.0064	1.0064
11	1.96	1.0071	1.0071
11	6.15	1.0057	1.0057
12	0.00	1.0083	1.0081
12	5.37	1.0083	1.0082
12	5.48	1.0077	1.0077
12	9.09	1.0101	1.0102
Mean		1.0079	1.0078

ASP:cs
ZBRDLE:21:5

Table 4

Dresden Unit 2 Cycles 11 and 12

Predicted Versus Measured TIP Results

Dresden Unit 2 Cycle	Cycle Exposure (GWD/MT)	% Standard Deviation (P-M)/MBAR x 100			
		Radial		Nodal	
		Original NFSR-0091	Corrected for Samarium Shuffling	Original NFSR-0091	Corrected for Samarium Shuffling
11	0.34	5.22	5.22	7.14	7.17
11	3.94	5.87	5.87	8.54	8.61
11	6.56	5.93	5.94	8.50	8.50
12	0.13	6.61	6.63	9.39	9.42
12	2.19	6.78	6.78	9.37	9.39
12	4.15	6.27	6.27	9.02	9.03
12	5.10	6.45	6.45	8.98	8.99
12	5.99	6.73	6.73	9.46	9.25
12	6.96	6.65	6.65	8.86	8.85
12	7.81	6.57	6.58	8.54	8.55
12	8.75	6.56	6.56	9.52	9.49
12	9.78	6.37	6.37	9.86	9.95
Average		6.33	6.34	8.93	8.93

P = Predicted
M = Measured
MBAR = Average of all Measured Values

ASP:cs
ZBRDLE:21:6

ATTACHMENT 2

COMMONWEALTH EDISON COMPANY TOPICAL REPORT

BENCHMARK OF CASMO/MICROBURN BWR NUCLEAR DESIGN METHODS

LASALLE COUNTY UNIT 2

(NFSR-0091, SUPPLEMENT 2, REVISION 0)