UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

U.S. Nuclear Regulatory Commission
Attention: Document Control Room
Washington D.C. 20555

October 2, 2006

Subject: Revision to FSAR Submitted in April 2004.

Docket No. 50-184
Gentlemen,
Please replace Chapter 13, section 13.2.2.2.2 with the attached information. The figure and table numbers will be modified when the final revisions are made. Please direct any questions concerning this issue to Dr. Wade J. Richards @ (301)-975-6260 or wade.richards@nist.gov.

Sincerely,

Wade J. Richards
Chief Reactor Operations and Engineering

I certify under penalty of perjury that the foregoing is true and correct.

Executed on 2 oct 2006 by Wade J. Richards

cc. Mr. Marvin Mendonca
NBSR Project Manager
U.S. Nuclear Regulatory Commission
Washington D.C. 20555

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13.2.2.2.2 Rapid Removal on an Experiment

A reactivity insertion accident has been analyzed using RELAP5 MOD3.3 and MATLAB [1]. For conservatism, no thermal-hydraulic feedback has been taken into account. A ramp reactivity insertion of 0.005ΔΔ was assumed to occur in 0.5 s, resulting in a total insertion of $0.66. Since the RELAP5 MOD3.3 point kinetics model was found to incorrectly predict the power excursion during the transient, the point kinetics equations were solved using MATLAB, and the resulting power table was input into RELAP5.

The transient reactor powers for beginning-of-cycle (BOC) and end-of-cycle (EOC) conditions are plotted in Figure 1.

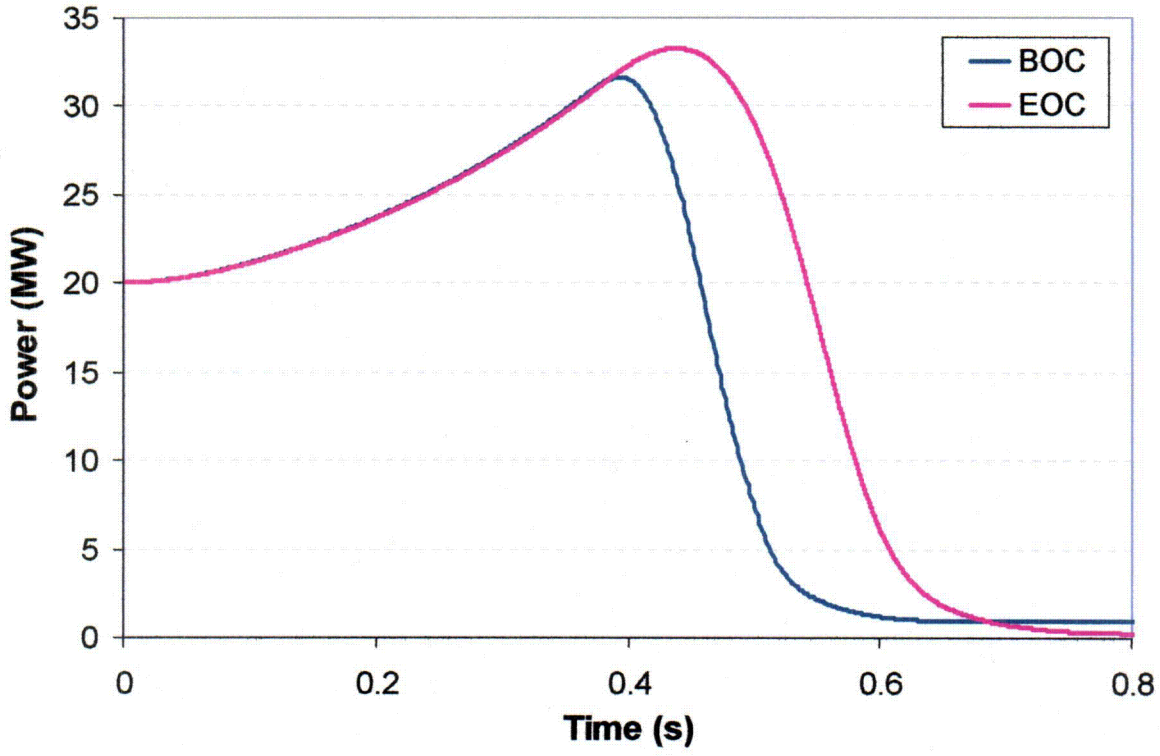

Figure 1 - Transient power as calculated with MATLAB

In both cases, the power exceeds the reactor trip setpoint (130% or 26 MW) at 267 ms, and the shim arms start inserting into the core at 366 ms. At this point, since the initial shim arm positions are different for BOC and EOC, the BOC and EOC powers begin to differ. For BOC conditions, power reaches a peak of 31.6 MW at 392 ms, whereas for EOC the peak is delayed and somewhat higher, 33.3 MW at 437 ms. This results in total excursion energies above 20 MW of 2.20 MJ for BOC and 3.01 MJ for EOC.

Figure 2 shows the shim arm reactivity for each initial condition. Note that for BOC the shim arms are initially partially inserted whereas they are completely withdrawn for EOC. Since the reactivity insertion rate is higher when the shim arms move from intermediate positions, the post-scram reactivity decreases more rapidly for BOC, resulting, as previously shown, in an earlier and lower power peak.

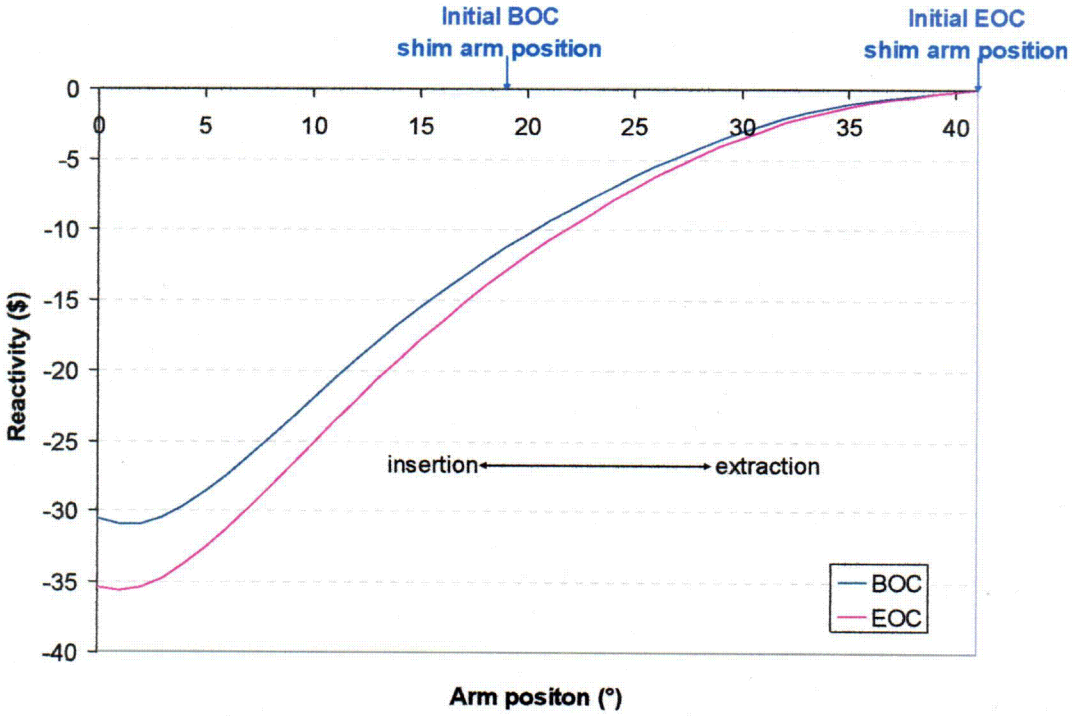

Figure 2 - Shim arm reactivity vs. position

To ensure the fuel plates will not be damaged during the accident, the ratio of critical heat flux to local heat flux at their surface (CHFR) is monitored and shown in Figure 3 for the hottest node of the fuel plates both in the inner and the outer parts of the core. The minimum transient CHFR is 1.74 for BOC and 2.01 for EOC, well above 1.538, the value that corresponds to a 99.9% probability that there is no overheating in any subregion of the core. Table 1 summarizes of the main results presented in this report, and Tables 2 and 3 show detailed results for BOC and EOC respectively.

Table 1 - Summary of results

	BOC	EOC
Peak Power (MW)	31.6	33.3
Time of Peak (ms)	392	437
Excursion Energy above 20 MW (MJ)	2.20	3.01
Minimum CHFR	1.74	2.01

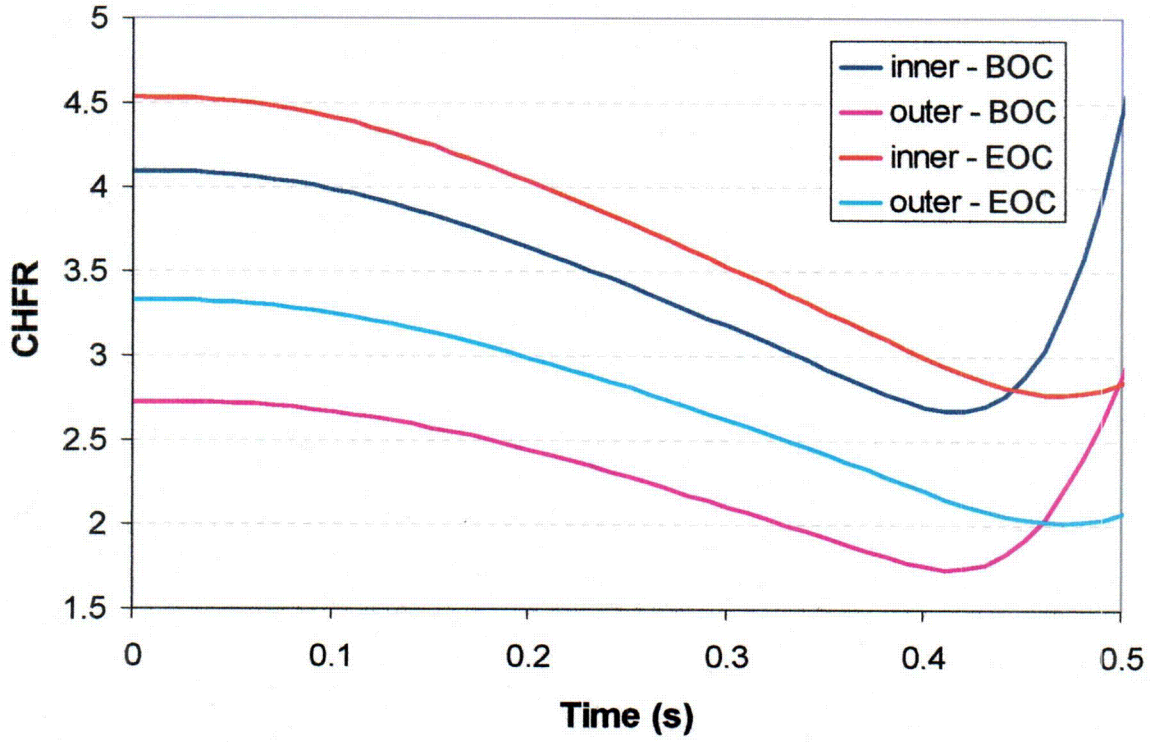

Figure 3 – CHFR inner and outer core

Table 2 - Reactor Response to Ramp Reactivity Insertion

Equilibrium Core – Beginning of Cycle

Time (s)	Power (MW)	CHFR Inner core	CHFR Outer core	Excursion energy (MJ)
0.00	20.0	4.09	2.73	0.00
0.01	20.0	4.09	2.73	0.00
0.02	20.1	4.09	2.73	0.00
0.04	20.2	4.08	2.72	0.00
0.06	20.5	4.06	2.71	0.01
0.08	20.8	4.03	2.69	0.02
0.10	21.1	3.99	2.66	0.04
0.12	21.5	3.93	2.63	0.07
0.14	22.0	3.87	2.59	0.10
0.16	22.5	3.80	2.55	0.15
0.18	23.1	3.72	2.49	0.21
0.20	23.7	3.64	2.44	0.27
0.22	24.3	3.55	2.38	0.35
0.24	25.0	3.46	2.31	0.45
0.26	25.8	3.36	2.24	0.56
0.28	26.6	3.27	2.17	0.68
0.30	27.4	3.17	2.10	0.82
0.32	28.3	3.07	2.03	0.98
0.34	29.3	2.97	1.96	1.16

0.36	30.3	2.87	1.89	1.35
0.38	31.3	2.78	1.81	1.57
0.40	31.5	2.69	1.75	1.80
0.42	29.6	2.67	1.74	2.01
0.44	25.2	2.77	1.82	2.16
0.46	19.0	3.04	2.04	2.20
0.48	12.5	3.58	2.40	2.20
0.50	7.4	4.48	2.90	2.20
0.52	3.9	5.87	3.65	2.20
0.54	2.5	7.82	4.65	2.20
0.56	1.8	10.36	5.90	2.20
0.58	1.4	13.62	7.43	2.20
0.60	1.2	17.73	9.26	2.20

Initial reactor power = 20 MW (equilibrium core – BOC)

Reactivity insertion rate = 0.5% Δk in 0.5 s

Initial shim arm position = 19°

Power scram initiated at 26 MW.

Table 3 - Reactor Response to Ramp Reactivity Insertion

Equilibrium Core – End of Cycle

Time (s)	Power (MW)	CHFR Inner core	CHFR Outer core	Excursion energy (MJ)
0.00	20.00	4.53	3.32	0.00
0.01	20.01	4.53	3.32	0.00
0.02	20.06	4.53	3.32	0.00
0.04	20.21	4.52	3.32	0.00
0.06	20.45	4.50	3.30	0.00
0.08	20.75	4.46	3.28	0.00
0.10	21.11	4.41	3.25	0.02
0.12	21.53	4.35	3.21	0.03
0.14	21.99	4.28	3.16	0.06
0.16	22.50	4.21	3.11	0.10
0.18	23.05	4.12	3.05	0.15
0.20	23.65	4.03	2.98	0.21
0.22	24.29	3.94	2.91	0.28
0.24	24.98	3.84	2.84	0.36
0.26	25.71	3.74	2.77	0.46
0.28	26.50	3.63	2.69	0.58
0.30	27.34	3.53	2.62	0.71
0.32	28.23	3.42	2.54	0.86
0.34	29.19	3.31	2.46	1.02
0.36	30.21	3.20	2.37	1.21
0.38	31.30	3.09	2.28	1.42

0.40	32.30	2.99	2.20	1.65
0.42	33.03	2.89	2.12	1.89
0.44	33.26	2.82	2.05	2.15
0.46	32.78	2.77	2.02	2.40
0.48	31.40	2.78	2.02	2.64
0.50	28.93	2.84	2.07	2.83
0.52	25.23	3.00	2.18	2.96
0.54	20.42	3.28	2.38	3.01
0.56	15.06	3.77	2.69	3.01
0.58	9.99	4.55	3.15	3.01
0.60	6.05	5.74	3.86	3.01
0.62	3.55	7.48	4.87	3.01
0.64	2.19	9.86	6.20	3.01
0.66	1.45	12.93	7.86	3.01
0.68	1.00	16.81	9.85	3.01
0.70	0.70	21.68	12.19	3.01

Initial reactor power = 20 MW (equilibrium core – EOC)

Reactivity insertion rate = 0.5% Δk in 0.5 s

Initial shim arm position = 41°

Power scram initiated at 26 MW.

References

[1] L. Cheng et al., "Physics and Safety Analysis for the NIST Research Reactor", BNL-NIST-0803, Rev.1, April 2004