Telephone 617 366-9011
TWX
710-380-0739

YANKEE ATOMIC ELECTRIC COMPANY

YANKEE

20 Turnpike Road Westborough, Massachusetts 01581

WYR 78-35

April 6, 1978

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation

Reference: (a) License No. DPR-3 (Docket No. 50-29)
(b) Proposed Change No. 155, Supplement No. 1, dated December 14, 1977, WYR 77-127
(c) NRC letter to YAEC dated March 16, 1978

REGULATORY DOCKET FILE COPY

Dear Sir:

Subject: Additional Information Incore Detector System
Technical Specification Changes

The additional information requested in Reference (c) is provided in Attachment I. The questions are answered in the same order in which they were asked.

The analysis in response to the first question has not been completed, but will be submitted on or before May 15, 1978.

Any further questions regarding the enclosure should be directed to Mr. Richard J. Cacciapouti at our Engineering Office, 20 Turnpike Road, Westborough, Massachusetts, 01581, (617) 366-9011, Extension 2807.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

WP Johnson
W. P. Johnson
Vice President

COMMONWEALTH OF MASSACHUSETTS)
)ss.
COUNTY OF WORCESTER)

Then personally appeared before me, W. P. Johnson, who being duly sworn did state that he is Vice President of Yankee Atomic Electric Company, that he is duly authorized to execute and file the foregoing request in the name and on the behalf of Yankee Atomic Electric Company and that the statements therein are true to the best of his knowledge and belief.

P

Robert H Groce
Robert H. Groce Notary Public
My Commission Expires September 14, 1984

8011170 452

7810400204

A001
S
3/40

ATTACHMENT I

Additional Information
Concerning Proposed Reduction of Incore Neutron
Detector Thimbles at Yankee Rowe

A-1. A study to demonstrate the ability to detector fuel misloading during startup tests with the reduced compliment of incore detector thimbles is in progress. Results of this analysis will be submitted by Mar 15, 1978.

A-2. To verify th[illegible]nimum of twelve neutron detector thimbles would be capable [illegible]ing a meaningful power distribution, a number of cases were [illegible] the INCORE program. The base case was the flux map produce[illegible]oximately 2800 MWD/MTU. Using all 17 available thimbles, a [illegible] of power distributions were also produced for a reduced comp[illegible] of thimbles. All but 12 thimbles were discarded in a random fashion with the only restriction being that each quadrant contain at least two operable thimbles.

The Yankee INCORE analysis procedure requires that the linear heat generation rate (LHGR) for the hottest fuel pins in each assembly be obtained from INCORE. Table 1 presents the maximum LHGR for the six hottest rods in the INCORE analysis both for the base case (17 thimbles) and for the cases with the reduced number of thimbles (12 thimbles). This analysis showed that in most instances , the reduced number of thimbles produced a higher measured LHGR. Since peak LHGR increased over the base case, it is concluded that it would not be necessary to place an additional uncertainty on the measured peak LHGR for Yankee Rowe with a reduced compliment of thimbles.

This conclusion is further substantiated by a comparison of the measured and calculated (PDQ) reaction rates. For the base case and the ten cases with a reduced number of thimbles, the measured and calculated reaction rates were compared. The comparison for all cases is shown in Figures 1 through 11. The results show that on the average, the difference between measured and calculated reaction rates is relatively stable. Thus, it appears that a reduced compliment of thimbles does not have a marked effect on the INCORE synthesis procedure. This can also be seen by a comparison of the full core assembly powers and pin powers shown in Figures 12 and 13.

A-3. It is Yankee's plan to monitor core tilt by means of the tilt algorithm in the INCORE computer program. From the cases run for 2 above, the core tilt as calculated by INCORE was compared for all cases. As Table 2 shows, the quadrant tilt is not adversely affected by a reduction in the number of thimbles from 17 to 12. Thus, the use of the INCORE tilt algorithm to monitor core tilt still appears to be a reasonable appears to be a reasonable approach.

The following is in response to the other portions of question 3.

a. Yankee believes that core tilt can be monitored by means of loop flows; however, to demonstrate the validity of this approach would require some type of testing and calculational analysis. This testing and analysis has not been done and is not planned for the future.

b. With the current compliment of thimbles, there is only one set of quadrant symmetric thimbles. To require this one set to remain operable is unreasonable and defeats the intent of the proposed Technical Specification change. As was shown from the analyses performed, quadrant tilt can effectively be monitored with a reduced number of thimbles.

A-4. Based on the result of the studies performed, the Technical Specification changes presented in Proposed Change No. 155, Supplement No. 1 are still valid.

Table 1

Maximum Linear Heat Generation Rate Comparison Between 17 and 12 Available Thimbles

Case	Assembly Containg Pin with Maximum LHGR						% Difference Max. LHGR
	C-3	D-9	B-7	C-3	H-8	B-4	
Base+	10.303*	10.211	10.129	10.086	10.022	9.999	-
Case 1	10.170*	10.083	10.046	10.108	10.045	10.021	-1.29
Case 2	10.163*	10.075	10.147	10.103	10.040	10.016	-1.36
Case 3	10.538*	10.447	10.163	10.083	10.019	9.996	+2.28
Case 4	10.513*	10.410	10.244	10.163	10.099	10.075	+2.04
Case 5	10.370	10.269	10.352	10.198	10.041	10.479*	+1.71
Case 6	10.544*	10.454	10.170	10.089	10.006	10.002	+2.34
Case 7	10.486*	10.395	10.113	10.206	10.001	10.118	+1.78
Case 8	10.291	10.199	10.117	10.248	10.041	10.531*	+2.21
Case 9	10.374*	10.273	10.109	10.029	10.244	9.942	+0.69
Case 10	10.358*	10.265	10.183	10.139	10.124	10.052	+0.53

* Maximum value + Base contains 17 thimbles all other cases contain 12 thimbles

Table 2
Comparison of Relative Quadrant Tilt Between 17 and 12 Available Thimbles

Case	Quadrant 1	Quadrant 2
Base*	1.0018	.9886
1	.9997	.9907
2	.9991	.9901
3	.9971	.9881
4	.9995	.9912
5	1.0051	.9843
6	1.0023	.9876
7	1.0062	.9839
8	1.0074	.9830
9	.9965	.9785
10	1.0038	.9866

	Quadrant 3	Quadrant 4
Base	1.0071	1.0024
1	1.0066	1.0030
2	1.0079	1.0028
3	1.0140	1.0008
4	1.0085	1.0009
5	1.0097	1.0009
6	1.0130	.9971
7	1.0094	1.0006
8	1.0073	1.0022
9	1.0046	1.0204
10	1.0102	.9994

*Base contains 17 thimbles, all other cases contain 12 thimbles

Figure 1
Comparison of Measured and Calculated Reaction Rates
BASE CASE

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1					.710 .731 -2.92					
2						1.009 1.050 -3.85				
3							1.094 1.115 -1.88			
4			1.107 1.115 -.68		1.092 1.068 2.28					
5	.745 .733 1.56			1.098 1.071 2.52				1.052 1.063 -.96		
6							1.101 1.071 2.82			
7		1.068 1.070 -.12				1.102 1.068 3.23		1.103 1.115 -1.07		
8				1.113 1.115 -.16			1.099 1.111 -1.09			
9			.733 .724 1.14		1.039 1.050 -1.07					
10						.734 .731 .41				

Average Absolute Percent Difference = 1.63

Figure 2
Comparison of Measured and Calculated Reaction Rates

Case 1

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1										
2						.931 .968 -3.85				
3							1.009 1.028 -1.88			
4			1.021 1.028 -.68		1.007 .985 2.28					
5				1.013 .988 2.52				.971 .980 -.96		
6							1.016 .988 2.82			
7						1.016 .985 3.23		1.017 1.028 -1.07		
8				1.027 1.028 -.162			1.014 1.025 -1.09			
9					.958 .968 -1.07					
10										

Average Absolute Percent Difference = 1.80

Figure 3

Comparison of Measured and Calculated Reaction Rates

Case 2

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1										
2						.929 .967 -3.92				
3							1.007 1.027 -1.95			
4			1.019 1.027 -.75		1.005 .983 2.20					
5				1.010 .986 2.44				.968 .979 -1.03		
6							1.013 .986 2.74			
7		.983 .985 -.20				1.014 .983 3.16		1.015 1.027 -1.14		
8				1.024 1.027 -.24			1.012 1.023 -1.16			
9										
10										

Average Absolute Percent Difference = 1.74

Figure 4
Comparison of Measured and Calculated Reaction Rates
Case 3

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1										
2						.957 .997 -4.00				
3							1.037 1.059 -2.03			
4			1.050 1.059 -.83		1.035 1.014 2.12					
5				1.041 1.017 2.36				.998 1.009 -1.11		
6							1.044 1.017 2.66			
7		1.013 1.016 -.28				1.045 1.014 3.07		1.046 1.059 -1.22		
8							1.042 1.055 -1.24			
9			.694 .688 .98							
10										

Average Absolute Percent Difference = 1.83

Figure 5

Comparison of Measured and Calculated Reaction Rates

Case 4

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1					.741 .756 -1.95					
2						1.054 1.085 -2.89				
3							1.142 1.153 -.90			
4			1.156 1.153 .31							
5	.778 .758 2.57							1.099 1.099 .03		
6										
7		1.116 1.106 .87						1.152 1.153 -.08		
8							1.148 1.149 -.11			
9			.765 .749 2.14		1.084 1.085 -.09					
10						.766 .767 1.41				

Average Absolute Percent Difference = 1.11

Figure 6

Comparison of Measured and Calculated Reaction Rates

Case 5

	A	B	C	D	E	F	G	H	J	K
1					.741 .765 -3.13					
2						1.054 1.098 -4.06				
3										
4					1.136 1.117 1.74					
5	.775 .767 1.02			1.144 1.120 2.14				1.095 1.112 -1.48		
6							1.149 1.120 2.60			
7						1.150 1.117 3.01				
8							1.147 1.163 -1.30			
9			.762 .758 .61		1.081 1.098 -1.59					
10						.764 .765 -.12				

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

Average Absolute Percent Difference = 1.90

Figure 7
Comparison of Measured and Calculated Reaction Rates

Case 6

	A	B	C	D	E	F	G	H	J	K
1					.737 .757 -2.58					
2						1.049 1.087 -3.52				
3							1.137 1.155 -1.54			
4			1.151 1.155 -.34		1.135 1.106 2.63					
5	.774 .760 1.91			1.141 1.109 2.87				1.094 1.101 -.62		
6										
7		1.110 1.108 .22						1.147 1.155 -.73		
8										
9			.761 .750 1.48							
10						.763 .757 .76				

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

Average Absolute Percent Difference = 1.60

Figure 8

Comparison of Measured and Calculated Reaction Rates

Case 7

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1					.716 .736 -2.69					
2						1.019 1.057 -3.62				
3							1.104 1.123 -1.65			
4										
5				1.106 1.078 2.60				1.059 1.070 -1.03		
6							1.111 1.078 3.06			
7		1.075 1.077 -.20				1.112 1.075 3.48		1.113 1.123 -.84		
8							1.109 1.119 -.86			
9			.737 .729 1.06							
10						.738 .736 .34				

Average Absolute Percent Difference = 1.78

Figure 9

Comparison of Measured and Calculated Reaction Rates

Case 8

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1										
2						1.020 1.059 -3.63				
3										
4										
5	.750 .740 1.47			1.108 1.080 2.59				1.060 1.072 -1.04		
6										
7		1.076 1.079 -.21				1.114 1.077 3.46		1.115 1.124 -.85		
8				1.122 1.124 -.25			1.111 1.121 -.87			
9			.738 .730 1.05		1.046 1.059 -1.16					
10						.739 .737 .33				

Average Absolute Percent Difference = 1.41

Figure 10

Comparison of Measured and Calculated Reaction Rates

Case 9

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1					.738 .761 -2.96					
2						1.051 1.093 -3.90				
3							1.139 1.161 -1.93			
4			1.153 1.161 -.73		1.136 1.112 2.23					
5	.775 .764 1.51			1.143 1.115 2.47						
6										
7		1.112 1.114 -.17				1.147 1.112 3.18				
8										
9			.762 .754 1.09		1.081 1.093 -1.12					
10						.764 .761 .36				

Average Absolute Percent Difference = 1.80

Figure 11
Comparison of Measured and Calculated Reaction Rates
Case 10

Measured Reaction Rate
Calculated Reaction Rate
Percent Difference

	A	B	C	D	E	F	G	H	J	K
1					.737 .755 -2.35					
2						1.049 1.085 -3.29				
3							1.137 1.152 -1.31			
4			1.151 1.152 -.10							
5	.774 .758 2.15			1.141 1.106 3.11						
6										
7		1.110 1.105 .46								
8				1.157 1.152 .42			1.142 1.148 -.51			
9			.761 .748 1.72		1.079 1.085 -.50					
10						.763 .755 1.00				

Average Absolute Percent Difference = 1.41

Figure 12

Relative Assembly and Maximum Pin Power

Base Case

	A	B	C	D	E	F	G	H	J	K
1	Relative Assembly Power Fxy, Max. Pin/Core Power			.603 1.264	.762 1.294	.762 1.300	.600 1.269			
2			.782 1.517	1.116 1.580	1.074 1.506	1.082 1.497	1.122 1.557	.774 1.494		
3		.783 1.521	1.213 1.599	1.181 1.568	1.086 1.243	1.067 1.236	1.153 1.523	1.198 1.572	.772 1.499	
4	.634 1.322	1.157 1.585	1.173 1.561	1.090 1.294	1.151 1.519	1.139 1.475	1.059 1.269	1.156 1.537	1.138 1.569	.615 1.290
5	.801 1.357	1.130 1.560	1.094 1.268	1.157 1.514	1.059 1.279	1.060 1.275	1.136 1.488	1.081 1.267	1.101 1.527	.773 1.323
6	.793 1.342	1.117 1.547	1.100 1.277	1.154 1.505	1.063 1.280	1.065 1.289	1.157 1.507	1.087 1.266	1.111 1.545	.781 1.329
7	.620 1.306	1.148 1.589	1.170 1.554	1.073 1.282	1.154 1.501	1.157 1.511	1.085 1.285	1.169 1.555	1.143 1.579	.617 1.296
8		.790 1.530	1.225 1.613	1.176 1.551	1.088 1.258	1.093 1.269	1.163 1.555	1.208 1.593	.780 1.515	
9			.797 1.537	1.155 1.599	1.113 1.537	1.106 1.541	1.144 1.574	.778 1.511		
10				.624 1.308	.786 1.336	.788 1.333	.623 1.302			

Figure 13
Relative Assembly and Maximum Pin Power
Case 1

Relative Assembly Power
Fxy, Max. Pin/Core Power

	A	B	C	D	E	F	G	H	J	K
1				.598 1.255	.757 1.287	.760 1.302	.601 1.270			
2			.783 1.521	1.108 1.584	1.071 1.511	1.084 1.499	1.125 1.561	.776 1.498		
3		.785 1.525	1.215 1.603	1.184 1.572	1.088 1.248	1.069 1.239	1.155 1.526	1.201 1.575	.774 1.502	
4	.621 1.304	1.150 1.589	1.176 1.565	1.092 1.297	1.154 1.522	1.142 1.478	1.061 1.272	1.159 1.541	1.141 1.572	.616 1.293
5	.785 1.338	1.117 1.564	1.097 1.271	1.160 1.517	1.061 1.282	1.062 1.278	1.138 1.491	1.083 1.270	1.103 1.530	.788 1.326
6	.782 1.330	1.106 1.535	1.117 1.284	1.156 1.515	1.066 1.283	1.067 1.291	1.160 1.510	1.089 1.268	1.113 1.548	.782 1.332
7	.621 1.303	1.150 1.592	1.172 1.564	1.076 1.290	1.156 1.505	1.159 1.514	1.088 1.288	1.171 1.558	1.145 1.583	.619 1.299
8		.787 1.529	1.222 1.607	1.177 1.554	1.090 1.261	1.096 1.271	1.166 1.559	1.211 1.596	.782 1.519	
9			.789 1.529	1.151 1.593	1.114 1.537	1.102 1.542	1.139 1.577	.780 1.515		
10				.619 1.303	.782 1.335	.779 1.324	.615 1.291			