REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8302070504 DOC.DATE: 83/02/03 NOTARIZED: NO DOCKET #

FACIL:50-269 Oconee Nuclear Station, Unit 1, Duke Power Co. 05000269
50-270 Oconee Nuclear Station, Unit 2, Duke Power Co. 05000270
50-287 Oconee Nuclear Station, Unit 3, Duke Power Co. 05000287

AUTH.NAME	AUTHOR AFFILIATION
TUCKER,H.B.	Duke Power Co.

RECIP.NAME	RECIPIENT AFFILIATION
DENTON,H.R.	Office of Nuclear Reactor Regulation, Director
STOLZ,J.F.	Operating Reactors Branch 4

SUBJECT: Confirms info provided to NRC at 830114 Meeting re flux reduction programs associated w/pressurized thermal shock. Units predicted to exceed NRC screening criteria through operating life.

DISTRIBUTION CODE: A049S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 14
TITLE: OR Submittal: Thermal Shock to Reactor Vessel

NOTES:AEOD/Ornstein:1cy, 05000269
AEOD/Ornstein:1cy, 05000270
AEOD/Ornstein:1cy. 05000287

	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME		COPIES LTTR	COPIES ENCL
	NRR ORB4 BC	01	7	7				
INTERNAL:	ELD/HDS4	12	1	0	MURLEY,T		1	1
	NRR DIR		1	1	NRR VISSING,G04		1	1
	NRR/DHFS DIR		1	1	NRR/DL DIR		1	1
	NRR/DL/ADSA		1	1	NRR/DL/ORAB	11	1	0
	NRR/DSI DIR		1	1	NRR/DSI/RSB		1	1
	NRR/DST DIR		1	1	NRR/DST/GIB		1	1
	REG FILE	05	1	1	RES/DET		1	1
	RES/DRA		1	1	RGN2		1	1
EXTERNAL:	ACRS	10	6	6	LPDR	03	1	1
	NRC PDR	02	1	1	NSIC	06	1	1
	NTIS		1	1				
NOTES:			1	1				

TOTAL NUMBER OF COPIES REQUIRED: LTTR 34 ENCL 32

DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

February 3, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

The purpose of this letter is to confirm information provided to the NRC Staff at a meeting held on January 14, 1983, during which the subject of flux reduction programs as related to Pressurized Thermal Shock (PTS) was discussed. This letter summarizes the current status of all three Oconee units, with respect to RT_{NDT}, flux reduction options that have been considered, alternatives to flux reduction for delaying or avoiding reaching the screening criteria, and other aspects of the Babcock and Wilcox Owners Group PTS program.

The current status of each Oconee unit is provided in the attached Tables. Although the Staff has only indicated an interest in Oconee 2, data on all three Oconee units have been provided for completeness. To allow ease of comparison, the methodology used by Duke to calculate RT_{NDT} is the same as presented by the Staff in Appendix E of "NRC Staff Evaluation of Pressurized Thermal Shock" (November 17, 1982). The results for Oconee 2 indicate a flux reduction factor of 1.17 through 32 EFPY utilizing the present fuel management program. For the other two Oconee units, the flux reduction factors are less than one.

Duke Power has completed the implementation of the 18-month fuel cycle design which effectively reduces neutron fluence approximately 30 percent. By comparing the Staff calculations for Oconee 2 RT_{NDT}, which assumed a 12-month fuel cycle design, and the Duke calculations which utilized an 18-month fuel cycle design, the results are evident. The 18-month fuel design is economically desirable from a fuel management perspective, has minimal impact on operating limits, and has no impact on the core design considerations such as hot channel factors and DNBR. Inasmuch as the Oconee reactor vessels are not predicted to reach the Staff's screening criteria prior to the end of operating life, and inasmuch as several conservatisms exist with respect to the method used to predict RT_{NDT}, no additional flux reduction schemes beyond those presently in use and licensed on Oconee are deemed necessary. Table 4 provides a summary of the Oconee 2 fuel management history. Duke is nevertheless supporting activities in other areas, as detailed in the following.

During the meeting of January 14, 1983, several alternatives to flux reduction for delaying or avoiding reaching the screening criteria were discussed. The

A049

Staff's methodology for calculation of shift of RT_{NDT} is inherently conservative. The use of the Guthrie Correlation, which has not received extensive review by industry, may be overly conservative for the B&W vessel welds. An additional conservatism is the use of RT_{NDT} as an index to the lower bound of toughness test data rather than actual measured toughness. Duke is supporting efforts by B&W, the Oconee NSSS vendor, to better quantify the conservatisms present in the Staff methodology for predicting RT_{NDT} shift. The results of these efforts will be provided to the Staff within the next few months. These alternatives to the evaluation of additional flux reduction options are expected to confirm that significant conservatisms exist within the Staff methodology and to show that the Oconee reactor vessels can operate safety and will not exceed the proposed screening criteria through their design lifetimes.

Finally, Duke is supporting many additional activities related to PTS, all of which were discussed with the NRC Staff on January 11, 1983 and are summarized in the following. The PTS program activities fall into two broad categories: margin assessment and risk reduction. Within the area of margin assessment are plant specific analyses which have been completed on Oconee 1 and Three Mile Island I; improved mixing analysis methods and appropriate test data from the EPRI sponsored test program; improved fracture mechanics analysis techniques; improved fracture toughness correlations; and the use of data from other research programs such as the NRC sponsored HSST program. In the area of risk reduction Duke has taken several actions which include conducting comprehensive inspections of all three Oconee reactor vessels; developing and implementing appropriate procedural guidance; conducting operator training on PTS; and the implementation of several plant modifications to reduce the likelihood or to eliminate the possibility of secondary side upsets which could cause severe overcooling transients. Many of these modifications were the result of operating experience on plants with the B&W NSSS. In order to provide timely recognition of desirable plant modifications in the future, Duke has had established since 1980 a formal operating experience feedback program called the Transient Assessment Program (TAP). Duke, in association with other utilities which operate plants with the B&W NSSS, systematically reviews plant operating experience so as to improve plant operations. As a result of the meeting held on January 11, 1983, the Staff indicated a need for additional information in some of these areas. Duke is supporting activities that will provide the followup information requested and another meeting is planned for a March time frame.

In summary, none of the Oconee units are predicted to exceed the Staff's screening criteria through their operating life. Duke is, however, supporting efforts which assess the margin present in the existing analysis, Duke has completed many activities which serve to reduce the risk from PTS, and Duke has many continuing programs which will continue to support the safe operation of Oconee Nuclear Station.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

RLG/php
Attachments

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Mr. E. L. Conner, Jr.
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

NRC Resident Inspector
Oconee Nuclear Station

TABLE 1

OCONEE NUCLEAR STATION
UNIT 1

	NRC VALUE (Axial)	DUKE VALUE
EFPY as of 12/31/81	5.04	5.1 [1]
Fluence ($n/cm^2 \times 10^{19}$)	.273	.214 [1]
Copper Percent	.31	.31 [4]
Nickel Percent	.55	.55 [4]
Mean Initial RT_{NDT}	0	0
Mean ΔRT_{NDT}	138	129
$2\sqrt{\sigma_0^2 + \sigma_\Delta^2}$	59	59
RT_{NDT} as of 12/31/81	197	188
As of 12/31/81 RT_{NDT} Below Screening Criteria	79	82
Total Fluence E>1 Mev to meet Screening Criteria ($n/cm^2 \times 10^{19}$)	1.33	1.33
EFPY	5.04	5.1
Fluence ($n/cm^2 \times 10^{19}$)	.232	.214 [1]
Fluence per EFPY	.046	.033
Additional Fluence to Reach Screening Criteria ($n/cm^2 \times 10^{19}$)	1.100	1.116
Remaining EFPY in Plant Life (32 EFPY)	26.96	26.9
To Reach Screening Criteria at 32 EFPY: Fluence per EFPY ($n/cm^2 \times 10^{19}$)	.0408	.041
Flux Reduction Factor	1.1	.80

TABLE 2

OCONEE NUCLEAR STATION
UNIT 2

	NRC VALUE	DUKE VALUE
EFPY as of 12/31/81	4.71	4.82
Fluence ($n/cm^2 \times 10^{19}$) 18	.287	.217 [2]
Copper Percent	.35	.35 [4]
Nickel Percent	.71	.68 [4]
Mean Initial RT_{NDT}	0	0
Mean ΔRT_{NDT}	172	157
$2\sqrt{\sigma_o^2 + \sigma_\Delta^2}$	59	59
RT_{NDT} as of 12/31/81	231	216
As of 12/31/81 RT_{NDT} Below Screening Criteria	69	84
Total Fluence E>1 Mev to meet Screening Criteria ($n/cm^2 \times 10^{19}$)	.99	1.051
EFPY	4.71	4.82
Fluence ($n/cm^2 \times 10^{19}$)	.287	.217 [2]
Fluence per EFPY	.061	.036 [2]
Additional Fluence to Reach Screening Criteria $n/cm^2 \times 10^{19}$)	.703	.834
Remaining EFPY in Plant Life (32 EFPY)	27.29	27.18
To Reach Screening Criteria at 32 EFPY: Fluence per EFPY ($n/cm^2 \times 10^{19}$)	.0258	.0307
Flux Reduction Factor	2.4	1.17
To Reach Screening Criteria at 25 EFPY	***	.041
Flux Reduction Factor	***	.88

Approximately 23 EFPY more, at the current fluence per EFPY, until the screening criteria is equalled.

TABLE 3

OCONEE NUCLEAR STATION
UNIT 3

	NRC VALUE	DUKE VALUE
EFPY as of 12/31/81	4.78	4.86
Fluence ($n/cm^2 \times 10^{19}$) 18	.292	.231 [3]
Copper Percent	.24	.24 [4]
Nickel Percent	.63	.60 [4]
Mean Initial RT_{NDT}	0	0
Mean ΔRT_{NDT}	112	103
$2\sqrt{\sigma_o^2 + \sigma_\Delta^2}$	59	59
RT_{NDT} as of 12/31/81	171	162
As of 12/31/81 RT_{NDT} Below Screening Criteria	129	138
Total Fluence E>1 Mev to meet Screening Criteria ($n/cm^2 \times 10^{19}$)	5.04	5.35
EFPY	4.78	4.86
Fluence ($n/cm^2 \times 10^{19}$)	.292	.231 [3]
Fluence per EFPY	.061	.049 [3]
Additional Fluence to Reach Screening Criteria ($n/cm^2 \times 10^{19}$)	4.748	5.119
Remaining EFPY in Plant Life (32 EFPY)	27.22	27.14
To Reach Screening Criteria at 32 EFPY: Fluence per EFPY ($n/cm^2 \times 10^{19}$)	.174	.189
Flux Reduction Factor	.35	.26

References:

1. DPC-RS-1001, Reactor Vessel Pressurized Thermal Shock Evaluation; submitted by Duke Power on January 15, 1982.

2. BAW-1699, Analysis of Capsule OCII-A from DPC Oconee Nuclear Station Unit 2; submitted by Duke Power on January 12, 1982.

3. BAW-1697, Analysis of Capsule OCIII-B from DPC Oconee Nuclear Station Unit 3; submitted by Duke Power on January 12, 1982.

4. BAW-1511P, Irradiation-Induced Reduction in Charpy Upper-Shelf Energy of Reactor Vessel Welds; submitted by Duke Power on March 23, 1981.

TABLE 4

Cycle	Year Cycle Started	Fuel Management Scheme	Nominal EFPD	Reload Report Reference [1]	Peak Flux[2] n/cm^2-sec (E>1 Mev)	Peak Fluence per EFPY [n/cm^2 x 10^{19} (E>1 mcu)]
1	1973	OUT-IN-IN	440	FSAR	1.39(+10)	.044
2	1976	OUT-IN-IN	282	BAW-1425, Rev.1 April 1976	1.57(+10)	.049
3	1977	OUT-IN-IN	300	BAW-1452 June 1977	1.57(+10)	.049
4	1978	OUT-IN-IN	292	BAW-1491 August 1978	1.57(+10)	.049
5	1980	IN-OUT-IN	360	BAW-1565, Rev.1 March 1980	1.14(+10)	.036
6	1982	IN-OUT-IN	400	BAW-1691 August 1981	1.11(+10)	.036
*7	--	IN-OUT-IN	421		1.13(+10)(est.)	.036(est.)

* FINAL DESIGN, Refueling outage scheduled to start Fall 1983; Reload Report to be submitted Summer 1983.

1. Core maps for past, present, and future cycles attached.

2. BAW-1699, December 1981, Analysis of Capsule OCII-A from Oconee Nuclear Station, Unit 2. (Cycles 1, 2, 3, 4)

Figure 5-1. BOC (4 EFPD), Cycle 2 Two-Dimensional Relative Power Distribution — Full Power, Equilibrium Xenon, Normal Rod Positions (Groups 7 and 8 Inserted)

	8	9	10	11	12	13	14	15
H	1.40	1.27	1.22	1.17	1.21	0.85	0.77	0.60
K	1.27	1.41	1.37	1.23	1.23	[7] 0.57	0.69	0.59
L	1.22	1.37	1.18	1.13	[8] 1.12	0.95	0.95	0.52
M	1.17	1.23	1.13	1.35	1.29	1.24	0.92	
N	1.21	1.23	[8] 1.12	1.29	1.10	1.09	0.66	
O	0.85	[7] 0.57	0.95	1.24	1.09	0.72		
P	0.77	0.69	0.95	0.92	0.66			
R	0.60	0.59	0.52					

1

x — Inserted Rod Group No.

x.xx — Relative Power Density

Figure 5-1. BOC (4 EFPD), Cycle 3 Two-Dimensional Relative Power Distribution-Full Power, Equilibrium Xenon, Normal Rod Positions (Group 7 and 8 Inserted)

	8	9	10	11	12	13	14	15
H	1.10	1.24	1.46	1.28	1.40	0.94	7 0.46	0.65
K	1.25	1.41	1.31	1.34	1.14	1.00	0.80	0.73
L	1.46	1.31	7 0.74	1.16	8 0.93	0.92	1.17	0.69
M	1.28	1.34	1.17	1.14	0.90	0.89	1.00	
N	1.40	1.14	8 0.93	0.90	0.91	1.14	0.73	
O	0.94	1.00	0.92	0.89	1.14	0.67		
P	7 0.47	0.80	1.17	1.00	0.73			
R	0.65	0.73	0.69					

Legend	
X	INSERTED ROD GROUP NO.
X.XX	RELATIVE POWER DENSITY

Figure 5-1. BOC (4 EFPD) Cycle 4 Two-Dimensional Relative Power Distribution — Full Power, Equilibrium Xenon, Normal Rod Positions, Groups 7 and 8 Inserted

	8	9	10	11	12	13	14	15
H	1.04	1.16	1.00	0.93	1.37	0.84	7 0.43	0.62
K		1.38	0.86	1.11	0.98	1.06	0.78	0.71
L			7 0.59	1.15	8 1.13	1.04	1.26	0.70
M				1.29	1.05	1.33	1.16	
N					0.98	1.18	0.80	
O						0.84		
P								
R								

0	Inserted Rod Group No.
0.00	Relative Power Density

5

Figure 5-1. BOC (4 EFPD) Two-Dimensional Relative Power Distribution — Full Power, Equilibrium Xenon, Normal Rod Positions, Group 8 Inserted

	8	9	10	11	12	13	14	15
H	0.819	0.998	1.060	1.186	1.019	1.204	0.948	0.778
K		1.286	1.366	1.064	1.146	1.068	1.130	0.600
L			1.153	1.332	0.952 (8)	1.146	0.930	0.455
M				1.236	1.257	0.970	0.693	
N					1.155	1.135	0.451	
O						0.631		
P								
R								

1

Key	
X	Inserted rod group No.
X.XX	Relative power density

Figure 5-1. BOC 6 (4 EFPD) Two-Dimensional Relative Power Distribution — Full Power, Equilibrium Xenon, Normal Rod Positions, Group 8 Inserted

	8	9	10	11	12	13	14	15
H	0.945	1.107 *	1.055	1.280	1.097	1.253	1.037	0.500
K		1.046	1.250	1.163	1.236	1.174	1.123	0.508
L			1.113	1.224	8 / 0.926	1.196	0.906	0.398
M				1.082	1.201	1.109	0.899	
N					1.149	1.047	0.487	
O						0.605		
P								
R								

*Mark BZ demonstration assembly (once-burned).

X — Inserted rod group No.

XXX — Relative Power Density

PRELIMINARY
CYCLE 7

FIGURE 5-1

TWO DIMENSIONAL
RELATIVE POWER DISTRIBUTION

HFP, 004 EFPD, EQXE
Nominal Rod Positions

	8	9	10	11	12	13	14	15
H	0.879	1.009	1.011	1.239	1.056	1.312	1.030	0.614
K	1.007	1.092	1.251	1.039	1.249	1.182	1.219	0.580
L	1.010	1.250	1.066	1.231	0.933	1.232	0.896	0.409
M	1.237	1.038	1.230	1.108	1.226	1.055	0.874	
N	1.054	1.246	0.931	1.225	1.067	1.068	0.491	
O	1.308	1.177	1.229	1.054	1.067	0.595		
P	1.026	1.215	0.894	0.873	0.491			
R	0.612	0.579	0.408					