RESPONSES TO NRC QUESTIONS REGARDING ANO-2 CYCLE 3 TECHNICAL SPECIFICATION CHANGE

August, 1983

Combustion Engineering, Inc. Windsor, Connecticut

8310130109 830930 PDR ADOCK 05000368 P PDR

. . . .

. .

LEGAL NOTICE

This report was prepared as an account of work sponsored by Combustion Engineering, Inc. Neither Combustion Engineering nor any person acting on its behalf:

- a) Makes any warranty or representation, expressed or implied including the warranties of fitness for a particular purpose or merchantability, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
- b) Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method or process disclosed in this report.

Question:

Please describe the simulation cases used in support of the proposed ANO-2 Technical Specification change on incore detector operability. Also, provide the results of the simulation cases.

Response:

Simulation studies have been performed for the Arkansas Nuclear One Unit 2 reactor to evaluate the synthesis uncertainties for F_{xy} , F_g and F_r . The analysis method used was identical to that presented in the CECOR Topical (Reference 1).

In all, five test cases were analyzed. The base case had the largest number of instrument failures in Cycle 3 which had occurred up to the date of the analysis. Case 2 had the base failures plus random additional failures to yield 25% failed detectors and 25% failed string locations. Case 3 had the entire core central region, radially and axially, failed. This is a severe case, since it represents the loss of considerable input data for CECOR. Case 4 was executed such that two quadrants contained only one live detector each at two axial levels, while having selected failures in the other quadrants. Case 5 had eleven detectors failed at all five levels in one quadrant, leaving only one live string in that quadrant. The failed detector patterns for the five cases are summarized in Table 1.

Results of the synthesis uncertainty analysis are presented in Table 2. The results indicate that there is no deterioration in the uncertainties with failures up to the proposed limits. Further, the uncertainties are well below those given in the topical. This is because ANO-2 is a five detector plant and is using multi-level coupling coefficients. Five detectors and five axial modes give lower synthesis uncertainties than four detectors because of the better axial representation. Multi-level coefficients provide better radial representations of the core as a function of height than two-dimensional, single-level coefficients, leading to lower uncertainties.

The uncertainty values obtained in this study for ANO-2 have been confirmed in other studies on five-detector multi-level plants. These results have also shown uncertainties on the order of [0.5% to 1.5%].

Table 1

ANO-2 Simulation Cases

Case Number	Failed Dete	Failed Detectors (by level)			
1 (Base Ca	se) Level 1: Level 2: Level 3: Level 4: Level 5:	10,37,38,42 9,10,14,31,37,38,42 3,10,15,16,25,31,37,38,39,42,43 10,15,37,38,39,42 3,10,36,37,38,42,43			
2	Base case Level 2: Level 3: Level 4:	failures + 13,15,22,23,30,39 7,13,14,21,22,23,24,30 3,7,14,30,31,43			
3	Level 2: Level 3: Level 4:	11-37 11-37 38			
4	Level 1: Level 2: Level 3: Level 4: Level 5:	37,38,42 2,3,5-25 2,3,5-25 37,38,42 37,38,42			
5	Level 1: Level 2: Level 3: Level 4: Level 5:	3,4,8,9,10,15,16,17,19,24,25 3,4,8,9,10,15,16,17,19,24,25 3,4,8,9,10,15,16,17,19,24,25 3,4,8,9,10,15,16,17,19,24,25 3,4,8,9,10,15,16,17,19,24,25			

	Table 2		
ANO-2	Simulation	Study	of
Synthesis	S Uncertaint	ty Comp	onents

	<u>D(%)</u>	f	<u>k</u>	<u>S(%)</u>	<u>D+kS(%)</u>
F _{xy} *					
Actual Failures-				-	-
Base Case		13	2.671		
Additional Failures - Case 2 Case 3 Case 4 Case 5		13 13 13 13	2.671 2.671 2.671 2.671		:
Topical		260	1.810	L].
Fa*					
<u> </u>					
Actual Failures - Base Case	3	176	1.851		
Additional Failures -					
Case 2	Str. Cont.	176	1.851		S. S. & S. C. (1997)
Case 3	1.7548.2	176	1.851	1.1.1	
Case 4		176	1.851		영양 영양 영영
Case J		1/0	1.031	() () () () () () () () () ()	
Topical		216	1.830	L	•
F_*					
<u> </u>					11 - 14 <u>1.1.</u> 4
Actual Failures - Base Case	ΓΊ	176	1.851	Γ	- T
Additional Failures -					- 영화 한 명이
Case 2		176	1.851		
Case 3		176	1.851		1.1.1.1.1.1.1
Case 4		176	1.851		
Case 5		1/6	1.001		
Topical	LJ	216	1.830		

*Quoted in percent of peak box value