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September 30, 1992
LD-92-101

Mr. Robert C. Jones, Chief
Reactor Systems Branch
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: ABB Combustion Engineering Nuclear Fuel Performance Data for 1990 and 1991

Dear Mr. Jones:

Enclosed with this letter is fuel performance data for ABB Combustion Engineering Nuclear Fuel for the calendar years 1990 and 1991. This information is being provided as input to the 1990 and 1991 volumes of NUREG/CR-3950, Fuel Performance Annual Report. Text, tables, and graphs are provided. The format and information provided has been changed slightly from that provided in the past in order to more closely match the format and information used in the 1989 annual report.

We are pleased to be able to provide this information to the NRC. As in the past, we would appreciate the opportunity to review draft material that describes the performance of our fuel prior to publication.

If you have any questions on this matter, call me or Mr. Mario Robles of my staff at (203) 285-5215.

Very truly yours,

S. A. Toelle

S. A. Toelle
Manager
Nuclear Licensing

mr/lw

Enclosures: As Stated

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1990 Performance Summary for ABB CE Nuclear Fuel

Table 1a summarizes the number of ABB . fuel assemblies and fuel rods irradiated and/or discharged, and the batch average burnups achieved, during the 1990 calendar year. Table 2a provides the cumulative burnup experience of active and discharged ABB CE fuel through the end of 1990, also on a batch average basis. Tables 3a and 4a sub-divide the Table 2a cumulative burnup experience through 1990 by fuel lattice type (i.e., 14x14, 16x16, and other) for fuel rods and fuel assemblies, respectively. Table 5a summarizes the corrected coolant iodine-131 activities for PWRs with ABB CE fuel at the end of 1990, and compares the results with those for the end of 1987. Figure 1a further illustrates the continuous improvement in this INPO-developed fuel reliability indicator for ABB CE fuel over the period 1987 to 1990. The results for 1990 compare well with the performance reported by INPO for the U.S. PWR industry in 1990. Table 6a provides the status of the major ABB CE fuel research and development programs for 1990.

Based on fuel examinations conducted through the end of 1990, about 75% of the leaking fuel that was fabricated after 1983 (current fabrication process) and operated during the 1987 to 1990 period was caused by debris-induced fretting wear of the Zircaloy-4 fuel rod cladding. Many of these leaking fuel rods were removed and replaced with non-fueled rods during refueling outages using ABB CE fuel assembly reconstitution methods. The overall reliability of ABB CE fuel fabricated since 1983 and operating at the end of 1990, excluding failures caused by debris-induced fretting wear, is estimated to exceed 99.998%.

Table 11
'89

TABLE 1a Summary of ABB Combustion Engineering Fuel Irradiated and/or Discharged in 1990

Reactor/ Fuel Cycles	Fuel Batch	Number of Assemblies: In Reactor at End of Year	Number of Assemblies: Discharged During Year	Number of Fuel Rods: In Reactor at End of Year	Number of Fuel Rods: Discharged During Year	Batch-Averaged Burnup, MWd/MTU: On Dec. 31, 1990	Batch-Averaged Burnup, MWd/MTU: at Discharge
P Arkansas-2/ Cycle 8	F	17	0	4,012	0	44,800	------
	H	28	0	6,352	0	41,900	------
	J	68	0	15,312	0	34,400	------
	K	64	0	14,416	0	15,800	------
P Calvert Cliffs-1/ Cycle 10	K	69	0	12,144	0	33,500	------
	L	52	0	9,152	0	21,300	------
	M	92	0	15,280	0	10,600	------
P Calvert Cliffs-2/ Cycle 8*	H	69	0	12,144	0	43,000	------
	J	60	0	10,560	0	34,000	------
	K	88	0	14,800	0	22,000	------
P Fort Calhoun/ Cycles 12 & 13	M	41	3	7,048	504	31,800	33,000
	N	44	0	7,552	0	19,100	------
	P	40	0	6,784	0	5,500	------
P Maine Yankee/ Cycles 11 & 12	N	0	64	0	10,880	------	40,500
	P	72	0	12,400	0	33,400	------
	Q	72	0	12,464	0	21,500	------
	R	72	0	12,448	0	5,200	------
P Palo Verde-1/ Cycles 2 & 3	B	1	96	220	21,120	25,000	30,000
	C	52	12	12,016	2,704	27,000	34,000
	D	80	0	18,528	0	19,000	------
	E	108	0	24,240	0	7,000	------
P Palo Verde-2/ Cycles 2 & 3	B	1	68	220	14,960	24,000	30,200
	C	36	28	8,496	6,224	26,000	33,500
	D	108	0	24,400	0	18,000	------
	E	96	0	21,616	0	6,000	------

* Calvert Cliffs-2 did not operate during 1990.

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TABLE 1a Summary of ABB Combustion Engineering Fuel Irradiated and/or Discharged in 1990 (continued)

Reactor/ Fuel Cycles	Fuel Batch	Number of Assemblies		Number of Fuel Rods		Batch-Averaged Burnup, MWd/MTU	
		In Reactor at End of Year	Discharged During Year	In Reactor at End of Year	Discharged During Year	On Dec. 31, 1990	at Discharge
Palo Verde-3/ Cycles 1 & 2	A	0	69	0	16,284	------	15,300
	B	73	35	16,060	7,700	27,000	17,600
	C	64	0	14,720	0	25,000	------
	D	104	0	23,584	0	15,000	------
St. Lucie-2/ Cycles 5 & 6	D	0	4	0	944	------	44,000
	E	12	45	2,800	10,412	36,000	42,000
	F	49	27	11,380	6,156	32,000	34,000
	G	80	0	18,448	0	18,000	------
	H	76	0	17,456	0	1,000	------
San Onofre-2/ Cycle 5	A	1	0	236	0	21,000	------
	F	108	0	24,112	0	33,000	------
	G	108	0	24,112	0	12,500	------
San Onofre-3/ Cycles 4 & 5	A	1	5	236	1,180	15,000	31,000
	D	0	16	0	3,776	------	30,500
	E	0	88	0	20,320	------	35,000
	F	108	0	24,112	0	27,500	------
	G	108	0	24,112	0	5,500	------
Waterford-3/ Cycle 4	C	1	0	224	0	34,600	------
	D	48	0	11,232	0	39,000	------
	E	84	0	18,896	0	27,600	------
	F	84	0	18,896	0	8,700	------
Yankee Rowe/ Cycles 20 & 21	B	0	36	0	8,222	------	32,000
	C	36	4	8,222	868	17,000	20,000
	D	40	0	9,090	0	1,300	------

TABLE 2a ABB Combustion Engineering Burnup Experience With All-Zircaloy Assemblies: Status as of December 31, 1990

Fuel Assembly Batch Average Burnup, MWd/mtu	In-Core Fuel Assemblies with Pressurized Fuel Rods: No. of Fuel Assemblies	In-Core Fuel Assemblies with Pressurized Fuel Rods: No. of Fuel Rods	Discharged Fuel Assemblies with Pressurized Fuel Rods: No of Fuel Assemblies	Discharged Fuel Assemblies with Pressurized Fuel Rods: No. of Fuel Rods	Discharged Fuel Assemblies with Nonpressurized Fuel Rods: No. of Fuel Assemblies	Discharged Fuel Assemblies with Nonpressurized Fuel Rods: No. of Fuel Rods
0 to 3,999	116	26,546	0	0	0	0
4,000 to 7,999	424	89,200	6	1,048	0	0
8,000 to 11,999	92	15,280	25	4,400	208	40,500
12,000 to 15,999	397	89,466	516	114,088	190	35,351
16,000 to 19,999	204	44,528	424	84,952	24	3,840
20,000 to 23,999	321	61,052	263	50,396	0	0
24,000 to 27,999	66	15,160	954	188,290	0	0
28,000 to 31,999	323	70,616	1,221	231,722	0	0
32,000 to 35,999	497	101,920	1,043	211,202	0	0
36,000 to 39,999	13	3,024	432	87,304	0	0
40,000 to 43,999	145	29,728	467	89,462	0	0
44,000 to 47,999	17	4,012	4	944	0	0
48,000 to 51,999	0	0	3	579	0	0
52,000 to 55,999	0	0	1	176	0	0
56,000 to 59,999	0	0	4	702	0	0
	2,615	550,532	5,785	1,065,265	422	79,691

Total Assemblies Supplied = 8,400
Total Fuel Rods Supplied = 1,695,488

Not used '89

TABLE 3a ABB Combustion Engineering Fuel Rod Burnup Experience by Assembly Lattice Size: Status as of December 31, 1990

Batch Average Burnup, MWd/mtu	Number of Operating Fuel Rods			Number of Discharged Fuel Rods		
	14x14	16x16	Other*	14x14	16x16	Other*
0 to 3,999	0	17,456	9,090	0	0	0
4,000 to 7,999	19,232	69,968	0	1,048	0	0
8,000 to 11,999	15,280	0	0	16,148	0	28,752
12,000 to 15,999	0	81,244	8,222	42,935	91,220	15,284
16,000 to 19,999	7,552	36,976	0	44,344	44,448	0
20,000 to 23,999	36,416	24,636	0	25,276	23,392	1,728
24,000 to 27,999	0	15,160	0	81,034	107,256	0
28,000 to 31,999	7,048	63,568	0	136,552	73,080	22,090
32,000 to 35,999	35,104	66,816	0	93,660	109,320	8,222
36,000 to 39,999	0	3,024	0	39,008	48,296	0
40,000 to 43,999	12,144	17,584	0	54,474	34,988	0
44,000 to 47,999	0	4,012	0	0	944	0
48,000 to 51,999	0	0	0	349	230	0
52,000 to 55,999	0	0	0	176	0	0
56,000 to 59,999	0	0	0	702	0	0
	132,776	400,444	17,312	535,706	533,174	76,076

Operating Fuel Rods = 550,532
Discharged Fuel Rods = 1,144,956
Total Fuel Rods Supplied = 1,695,488

* ABB CE or Westinghouse 15x15 lattice with cruciform control blades (Palisades and Yankee Rowe).

TABLE 4a ABB Combustion Engineering Fuel Assembly Burnup Experience by Assembly Lattice Size: Status as of December 31, 1990

Batch Average Burnup, MWd/mtu	Number of Operating Fuel Assemblies			Number of Discharged Fuel Assemblies		
	14x14	16x16	Other*	14x14	16x16	Other*
0 to 3,999	0	76	40	0	0	0
4,000 to 7,999	112	312	0	6	0	0
8,000 to 11,999	92	0	0	97	0	136
12,000 to 15,999	0	361	36	247	387	72
16,000 to 19,999	44	160	0	256	192	0
20,000 to 23,999	212	109	0	151	104	8
24,000 to 27,999	0	66	0	476	478	0
28,000 to 31,999	41	282	0	795	326	100
32,000 to 35,999	201	296	0	536	471	36
36,000 to 39,999	0	13	0	222	210	0
40,000 to 43,999	69	76	0	316	151	0
44,000 to 47,999	0	17	0	0	4	0
48,000 to 51,999	0	0	0	2	1	0
52,000 to 55,999	0	0	0	1	0	0
56,000 to 59,999	0	0	0	4	0	0
	771	1,768	76	3,109	2,324	352

Operating Fuel Assemblies = 2,615
Discharged Fuel Assemblies = 5,785
Total Fuel Assemblies Supplied = 8,400

* ABB CE or Westinghouse 15x15 lattice with cruciform control blades (Palisades and Yankee Rowe).

TABLE 5a Comparison of Corrected* Coolant Iodine-131 Activities from 1987 and 1990 for ABB Combustion Engineering Fuel

Corrected Iodine-131 Activity Range, uCi/g	Percentage of Plants in Range: End of 1987	Percentage of Plants in Range: End of 1990
Greater than 0.05	23	0
0.005 to 0.05	38.5	33
0.0005 to 0.005	38.5	67
Less than 0.0005	0	0

	End of 1987	End of 1990
Average Plant Corrected Iodine-131 Activity, uCi/g	0.0304	0.0055
Median Plant Corrected Iodine-131 Activity, uCi/g	0.0181	0.0027

* Corrected for tramp uranium and normalized to the same cleanup rate using the standard INPO method, with reference date August 1989.

Table 2

TABLE 6a Major Fuel Research and Development Programs: Status Through 1990

Vendor	Fuel Type	Power Plant	Planned Number (Completed Number) of Operating Cycles	Scheduled Completion of Program	Interim Inspections to Date
ABB Combustion Engineering	14x14[a]	Calvert Cliffs-1	5 (5)	Completed	5
	14x14[a]	Fort Calhoun	6 (6)	Completed	4
	14x14[b]	Calvert Cliffs-1	5 (5), Part 1	Completed	5
			5 (5), Part 2	1993[h]	5
	14x14[c]	Calvert Cliffs-2	3 (0)	1997	0
	16x16[c]	St. Lucie-2	3 (2)	Completed	1
	16x16[c]	Arkansas-2[d]	3 (3)	Completed	3
	16x16[c]	San Onofre-2	2 (0)	1995	0
	16x16[e]	Arkansas-2	3 (3)	Completed	3
	16x16[e]	Palo Verde-1	3 (2)	Completed	3
	16x16[f]	Arkansas-2	5 (5)	1992[h]	5
	16x16[g]	Palo Verde-1	3 (1)	1994	2
	16x16[g]	Palo Verde-3	3 (0)	1997	0
	14x14[i]	Maine Yankee	12 (12)	1991	3

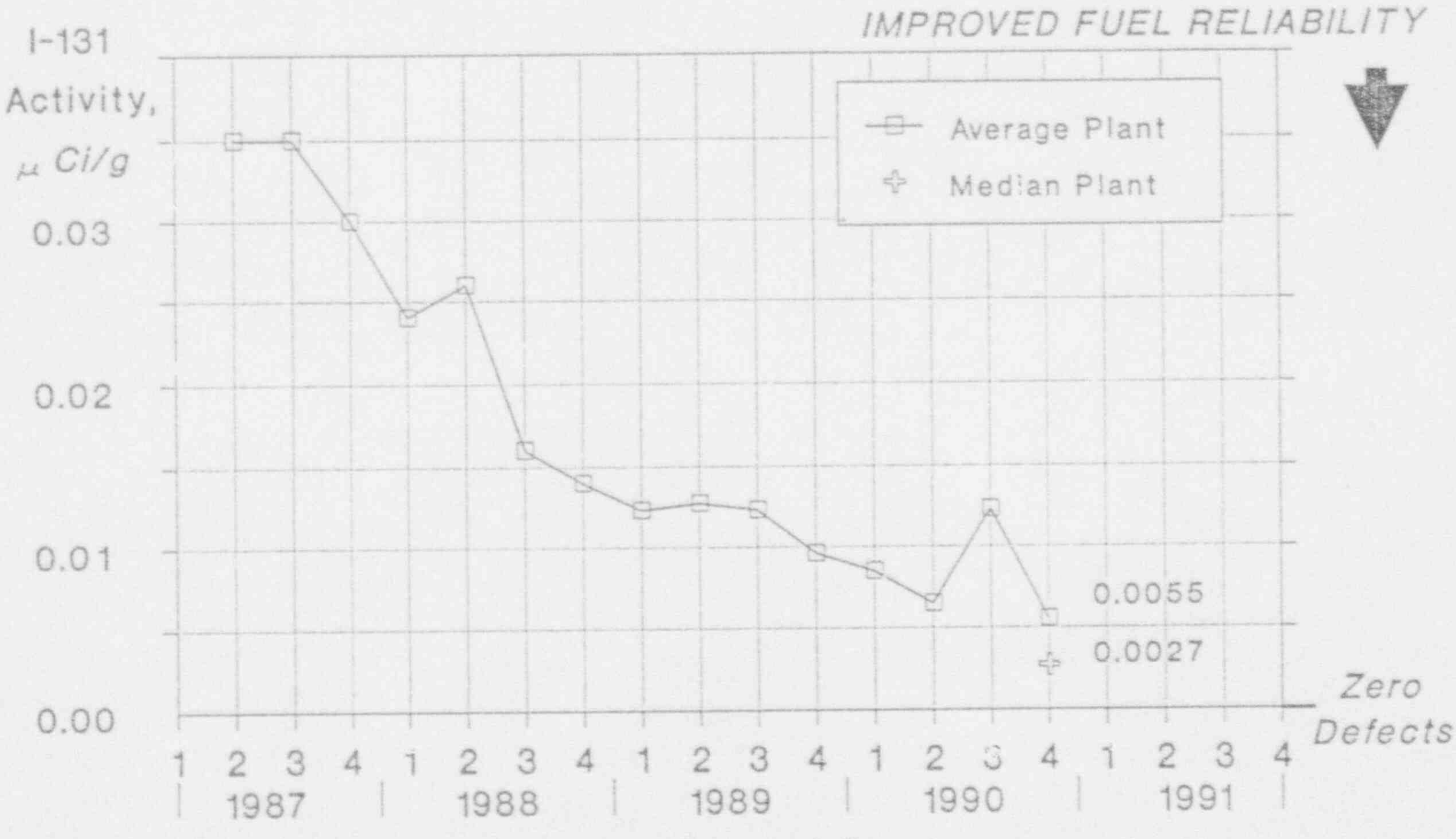
(a) Standard-design, high-burnup program.
(b) Standard and advanced fuel design LTAs.
(c) Burnable poison irradiation program.
(d) Arkansas Nuclear One-Unit 2 (also known as ANO-2).
(e) Standard surveillance program.
(f) Standard and advanced fuel design, including high burnup.
(g) Advanced cladding designs.
(h) Includes hot cell exam of high burnup fuel.
(i) Hot cell exam of high exposure control element assembly.

Fig 3
'89

Figure 1a

Corrected Coolant I-131 Activity* vs Time

U.S. PWR Plants with ABB CE Fuel



* INPO Standard Method

December 31, 1990