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SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ 6201 S Street, P.O. Box 15830, Sacramento CA 95852-1830, (916) 452-3211
AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

RJR 86-06

January 23, 1986

DIRECTOR OF NUCLEAR REACTOR REGULATION
ATTN FRANK J MIRAGLIA JR DIRECTOR
DIVISION OF PWR LICENSING-B
U S NUCLEAR REGULATORY COMMISSION
WASHINGTON D C 20555

ASSESSMENT OF FRACTURE TOUGHNESS OF THE RANCHO SECO REACTOR VESSEL

References:
1) Federal Register Vol. 50, No. 141, July 23, 1985
2) "Analyses of Capsule RS1-D Sacramento Municipal Utility District Rancho Seco Unit 1", BAW-1792, October, 1983
3) "Vessel Fluence Reduction - Fuel Cycle Study", BAW-1884, January, 1986
4) "Pressurized Thermal Shock Evaluations in Accordance with 10 CFR 50.61 for Babcock & Wilcox Owners Group Reactor Pressure Vessels", BAW-1895, January, 1986
5) "Evaluation of the Atypical Weldment", BAW-10144-A February, 1980

The District has evaluated the nil ductility transition temperature, adjusted for the effects of neutron irradiation (RT_{PTS}) in accordance with Reference 1, for Rancho Seco reactor vessel beltline material.

Table 1 presents neutron fluence values for the life of Rancho Seco. Values through Cycle 7 are based on actual fuel configurations in the reactor core. Values for Cycle 8 through the end of life are projections. Key assumptions are:

A049 1/1 Add:

AD - D. CHUTCHFIELD (ltr only)
EB (W. JOHNSTON)
RSB (THOMAS)
EICSB (PARR)
FOB (W. REGAN)

- Rancho Seco will go to a very low leakage fuel shuffle scheme (the "in-in-out" fuel shuffle) starting with Cycle 8.

- End of Cycle 7 fluence is conservatively estimated to occur on December 31, 1986.

- The fluence after Cycle 7 is conservatively based on a capacity factor of 80%.

Table 2 presents data for specific areas and welds of the reactor vessel. The abbreviated descriptions refer to the lower nozzle belt; upper and lower shells; upper, middle and lower circumferential welds; and upper and lower longitudinal welds. The last lower longitudinal weld was made from two heats, with ID referring to the inner 73% and OD referring to the outer 27%. The copper (CU) and nickel (NI) content and initial $RT_{NDT}(I)$ are as specified in Reference 4, which in turn references Babcock & Wilcox reports BAW-1820 and BAW-1799. The margin of uncertainty in RT_{NDT} is as specificed in Reference 1. Values of RT_{PTS} are given for equation 1 of Reference 1, since equation 1 gives the lower value in each case. NVT is the peak fluence seen by each area or weld. As can be seen from the table, the screening criteria are not violated.

There is a low probability that the lower longitudinal inside weld contains atypical weld material, as described in Reference 5. The Babcock & Wilcox Company has undertaken a study of this material, and has found that the actual neutron radiation response differs significantly from that predicted in Reference 1. Reference 4 describes the material properties and the basis for the projection of RT_{NDT}. The calculated value is 251°F at license expiration, at a fluence of 6.9 E18 n/cm^2, which does not violate the screening criterion.

Reference 4 will be submitted to you by the Babcock & Wilcox Company on behalf of the B&W Owners by January 23, 1986.

If you have any questions, please contact Rich Myers of my staff at (916) 732-6023.

R. J. RODRIGUEZ
ASSISTANT GENERAL MANAGER,
NUCLEAR

TABLE 1

EXTRAPOLATION* OF PRESSURE VESSEL FLUENCE

Cycle	Peakflux >1Mev at Vessel Wall ($n/cm^2/sec$ at full power)	Fluence/EFPY ($n/cm^2 \times 10^{19}$)	Cycle EFPY	Integrated EFPY	Peak Cycle ($n/cm^2 \times 10^{19}$)	Peak Integrated ($n/cm^2 \times 10^{19}$)
1 to 3	1.94×10^{10}(c)	.06122	2.82	2.82	.1726	.1726
4	1.30×10^{10}(c)	.04125	.63	3.45	.0260	.1986
5	1.34×10^{10}(c)	.04229	.83	4.28	.0351	.2337
6	1.09×10^{10}(c)	.03440	.94	5.22	.0323	.2660
7(a)	1.12×10^{10}(d)	.0358	.10	5.32	.0036	.2696
7	1.12×10^{10}	.0358	.93	6.15	.0333	.2993
8 to (b)	7.51×10^{9}	.0237(e)	17.42	23.57	.4129	.7122

(a) = January 1, 1986 - Present date (for submittal)

(b) = October 11, 2008 - Present license expiration.

(c) = Value from Table D-2 of BAW-1792 (Reference 2).

(d) = Cycle 7 from Telecon to B&W December 5, 1985.

(e) = Cycle 8 value = Cycle 7 value divided by VLL flux ratio (1.51) from Table 4-2 of BAW 1884 (Reference 3).

*CF = .80, EOC 7 = December 31, 1986

TABLE 2

RTPTS VERSUS TIME

RTPTS CALCULATED FOR JANUARY 1, 1986 (PRESENT DATE)

WELD	HEAT #	CU	NI	I	M	SCREEN	RTPTS	NVT
NZ BLT	FV4823	.15	.68	10.	48.	270.	120.	2.0 E+18
U SHELL	C50621	.12	.60	4.	48.	270.	102.	2.7 E+18
U SHELL	C50622	.12	.60	-10.	48.	270.	88.	2.7 E+18
L SHELL	C50701	.10	.58	-20.	48.	270.	68.	2.7 E+18
L SHELL	C50702	.10	.58	-20.	48.	270.	68.	2.7 E+18
U CIRC	WF-233	.29	.68	0.	59.	300.	186.	2.0 E+18
M CIRC	WF-154	.31	.59	0.	59.	300.	199.	2.7 E+18
L CIRC	WF-233	.29	.68	0.	59.	300.	186.	2.0 E+18
U LN	WF-29	.23	.63	0.	59.	270.	162.	2.6 E+18
L LN	WF-29	.23	.63	0.	59.	270.	163.	2.6 E+18
L LN ID	WF-70	.35	.59	0.	59.	270.	217.	2.6 E+18
L LN OD	WF-29	.23	.63	0.	59.	270.	163.	2.6 E+18

RTPTS CALCULATED FOR OCTOBER 11, 2008 (LICENSE EXPIRATION)

WELD	HEAT #	CU	NI	I	M	SCREEN	RTPTS	NVT
NZ BLT	FV4823	.15	.68	10.	48.	270.	140.	5.4 E+18
U SHELL	C50621	.12	.60	4.	48.	270.	118.	7.1 E+18
U SHELL	C50622	.12	.60	-10.	48.	270.	104.	7.1 E+18
L SHELL	C50701	.10	.58	-20.	48.	270.	81.	7.1 E+18
L SHELL	C50702	.10	.58	-20.	48.	270.	81.	7.1 E+18
U CIRC	WF-233	.29	.68	0.	59.	300.	225.	5.4 E+18
M CIRC	WF-154	.31	.59	0.	59.	300.	241.	7.1 E+18
L CIRC	WF-233	.29	.68	0.	59.	300.	225.	5.4 E+18
U LN	WF-29	.23	.63	0.	59.	270.	193.	6.8 E+18
L LN	WF-29	.23	.63	0.	59.	270.	194.	6.9 E+18
L LN ID	WF-70	.35	.59	0.	59.	270.	265.	6.9 E+18
L LN OD	WF-29	.23	.63	0.	59.	270.	194.	6.9 E+18