Docket File
PI 22

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 2, 1992

Docket Nos. 50-295
and 50-304

Mr. Thomas J. Kovach
Nuclear Licensing Manager
Commonwealth Edison Company-Suite 300
OPUS West III
1400 OPUS Place
Downers Grove, Illinois 60515

Dear Mr. Kovach:

SUBJECT: ZION STATION, UNITS 1 AND 2, FRACTURE TOUGHNESS REQUIREMENTS FOR PROTECTION AGAINST PRESSURIZED THERMAL SHOCK EVENTS, 10 CFR 50.61 (TAC NOS. M84546 AND M84547)

In a letter dated May 22, 1992, you provided the staff an assessment of the pressurized thermal shock reference temperature (RT_{PTS}) values for the reactor vessels of Zion Station, Units 1 and 2, which are Westinghouse designed reactors. In your analysis, the unirradiated reference temperature value for the limiting weld metal (weld metal fabricated from Linde 80 flux and heat number 72105 weld wire) was determined from the mean value of all heat number 72105 weld metal data with stress relief times of less than 35 hours. Data with stress relief times greater than 35 hours were not included in your evaluation.

The increase in reference temperature resulting from neutron irradiation was determined from the analysis of surveillance data from welds fabricated from Linde 80 flux and heat number 72105 weld wire. Data were available from both Westinghouse and Babcock and Wilcox designed reactor vessels.

The staff's consultant, Oak Ridge National Laboratory (ORNL), performed an analysis of Linde 80 weld, base metal and standard reference materials irradiated in Westinghouse and Babcock and Wilcox designed reactor vessels using the Power Reactor Embrittlement Data Base. The enclosed data indicate that for the same material and neutron fluence, reactor vessels designed by Westinghouse will have greater neutron embrittlement than reactor vessels designed by Babcock and Wilcox. This could be attributed to lower operating temperatures of the Westinghouse designed reactors or to a difference in neutron spectra. Hence, based on this data, the increase in reference temperature resulting from neutron irradiation should be determined from welds fabricated from Linde 80 flux and heat number 72105 weld wire, which were irradiated in surveillance capsules in Westinghouse designed reactor vessels.

Although Zion 1 and 2 have Westinghouse designed reactor vessels, your conclusions for the increase in reference temperature for Zion weld metal were based on data from surveillance capsules irradiated in Babcock and Wilcox designed reactor vessels.

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We request that you provide, within 60 days of the date of this letter, the basis (mechanistic and statistical) for not including in your analysis unirradiated data with stress relief times greater than 35 hours and the basis for concluding that the increase in reference temperature for Zion weld metal may be determined from surveillance data irradiated in Babcock and Wilcox designed reactor vessels. Plant specific irradiation temperatures and spectra should be included in your evaluation of the effect of neutron irradiation on the increase in reference temperature.

In addition, the surveillance data in Table 2 of your analysis are different than the data in previous surveillance reports. You should provide the Charpy impact data and curves that were used to determine the increase in the 30 ft-lb transition temperature and identify the neutron transport code, the scattering cross-sections and quadrature approximations used in determining the neutron fluences of the capsules.

If you have any questions, please contact me.

Sincerely,

Original signed by:

Clyde Y. Shiraki, Senior Project Manager
Project Directorate III-2
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosure:
ORNL Data Analysis for the
Evaluation of the Irradiation
Temperature Effects

cc w/enclosure:
see next page

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Mr. Thomas J. Kovach
Commonwealth Edison Company

Zion Nuclear Power Station
Unit Nos. 1 and 2

cc:

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Subject: Additional Data Analysis for Eva' ,ation of Irradiation Temperature Effects

The following study is the continuation of the residual studies for the irradiation temperature effects, dated April 8, 1992. The statistical Analysis will not include the data whose absolute residual value is greater than 100°F, however, the data point will be retained in the plot.

Two categories of data analysis were carried out in this study, the detailed analysis for each category is stated as below:

I. Westinghouse's surveillance data whose materials are from B&W supplied-vessels.

In this category, only the weld materials are available from PR-EDB. A residual plot was generated for this category, the mean residual value (-1.8°F) and two sigma bounds (52.48°F) were also marked in the plot, see Figure 1. The residual plot could be interpreted to show a fluence dependence effect. At relative low fluences, say below 10^{18}nvt, Reg. Guide 199 underpredicted the shift value, and at fluences greater than $1.0x10^{18}$nvt, Reg. Guide 199 overpredicted the shift value.

II. Standard reference materials for Westinghouse and B&W plants.

In this category, only the surveillance data of the standard reference material, SHSS02 (HSST02), is available for both Westinghouse and B&W plants from PR-EDB. Two residual plots, figure 2-3, were generated for Westinghouse and B&W respectively. The corresponding mean residual and two sigma bounds are listed below:

Vendor	Mean ± Two Sigma
Westinghouse	-3.90 ± 34°F
Babcock & Wilcox	-44.18 ± 39°F

Two additional plots for B&W's base and weld materials are also included with this report. Both base and weld materials have -23°F mean residual, see figure 4-5. The Charpy specimens of different materials are distributed evenly within the B&W's surveillance capsule.

Subject: Data Selection Procedures Used in the Radiation Embrittlement Study

In order to carry out the radiation embrittlement studies more efficiently, a processed file, SHIFT_PR.dbf, was generated from PR-EDB data base. The criteria of data selection processes are defined as below:

Charpy shift data:	The reported shift data, DTT30, is chosen if found. If DTT30 data is not listed or can not be determined by subtraction of the unirradiated from the irradiated data, then DTT30 is determined from F.W. Stallmann's TANH fit program.
Fluence data:	If there are two or more reported fluences for one capsule, then the vendor's value is chosen.
Chemistry data:	Manufacturer's data are chosen if available. If the manufacturer's data is not available, then the specimen data are used.

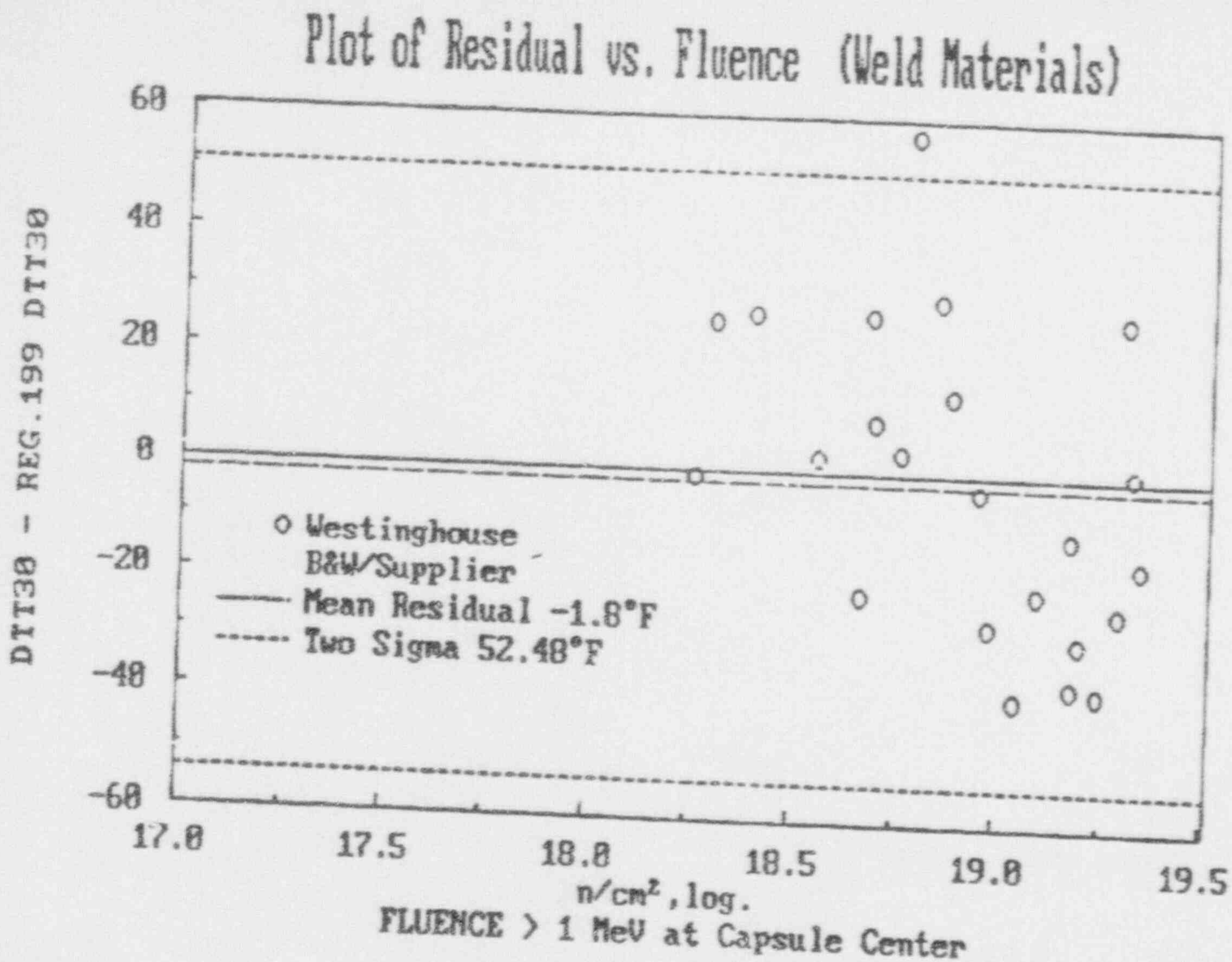

Figure 1. Plot of Residual versus Fluence for Westinghouse with B&W Supplier

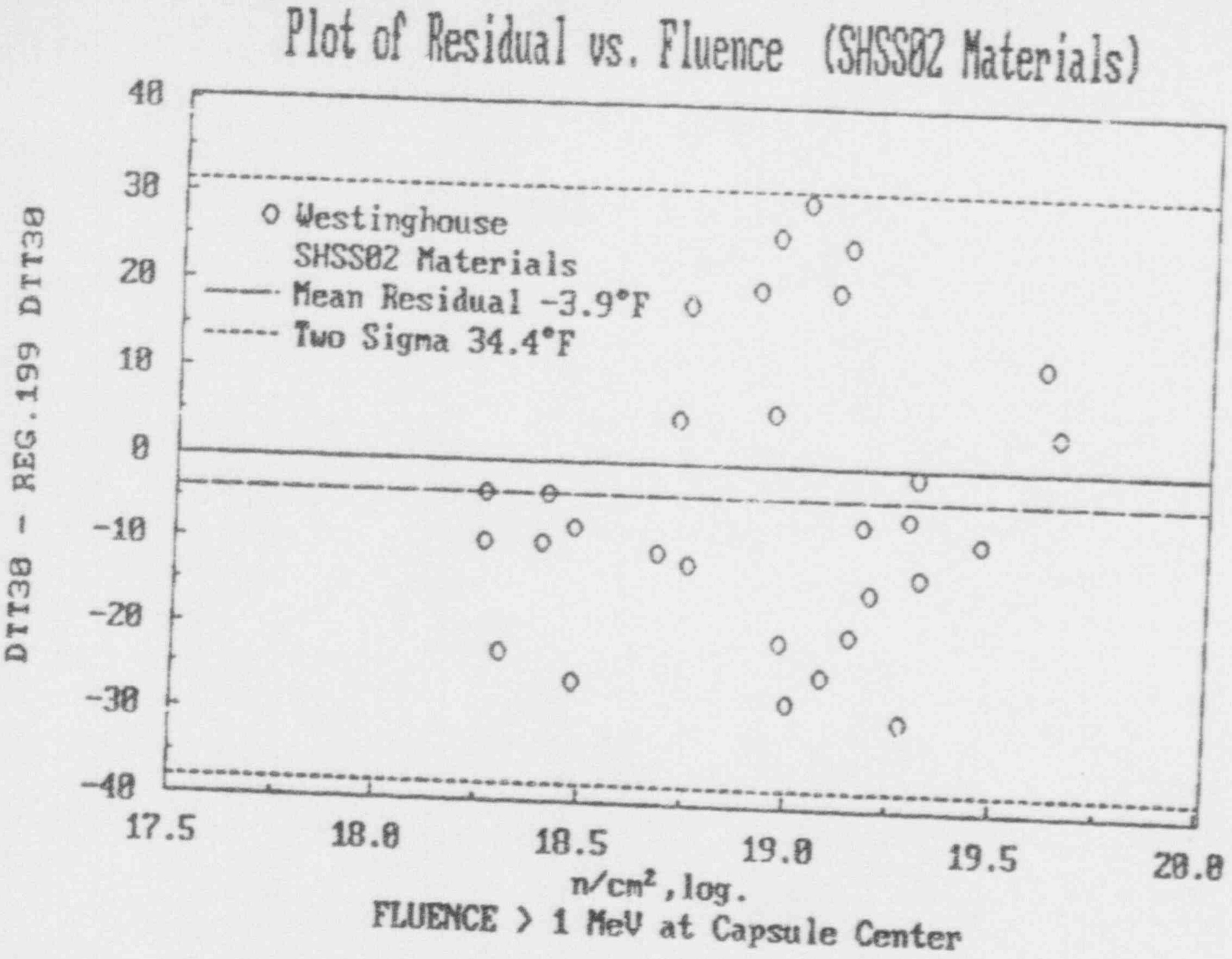

Figure 2. Plot of Residual versus Fluence for Westinghouse SHSS02 Material

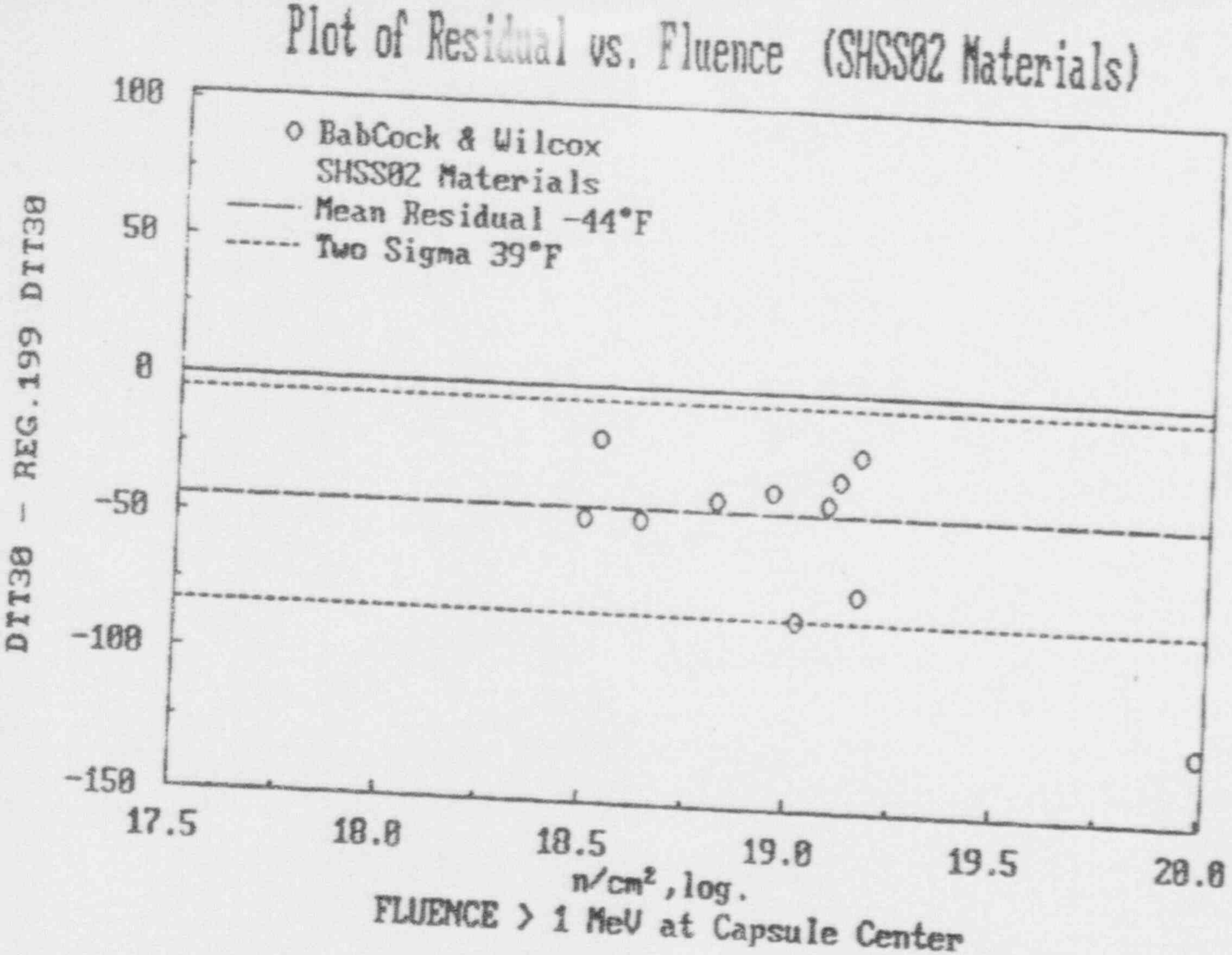

Figure 3. Plot of Residual versus Fluence for B&W SHSS02 Material

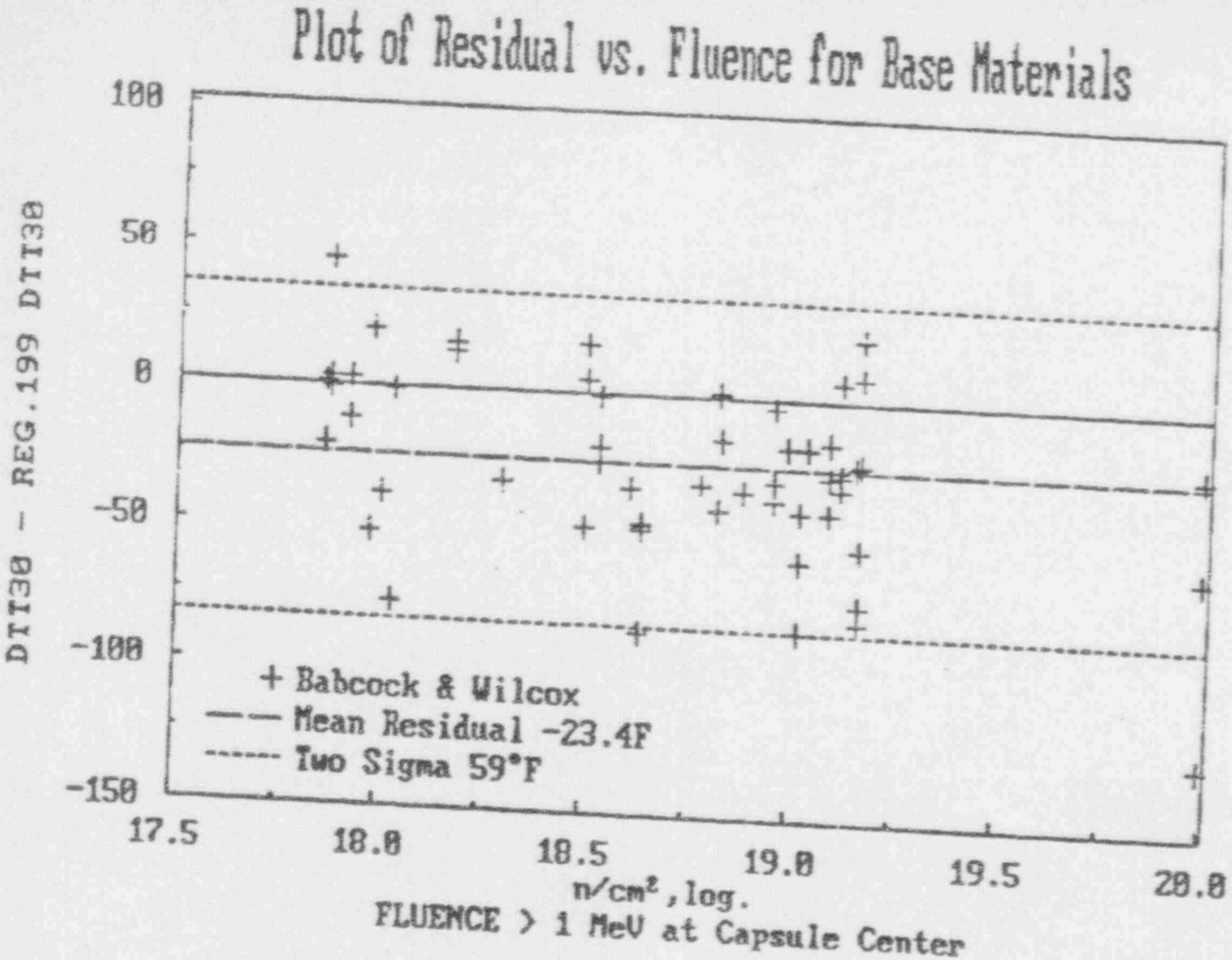

Figure 4. Plot of Residual versus Fluence for B&W Base Materials

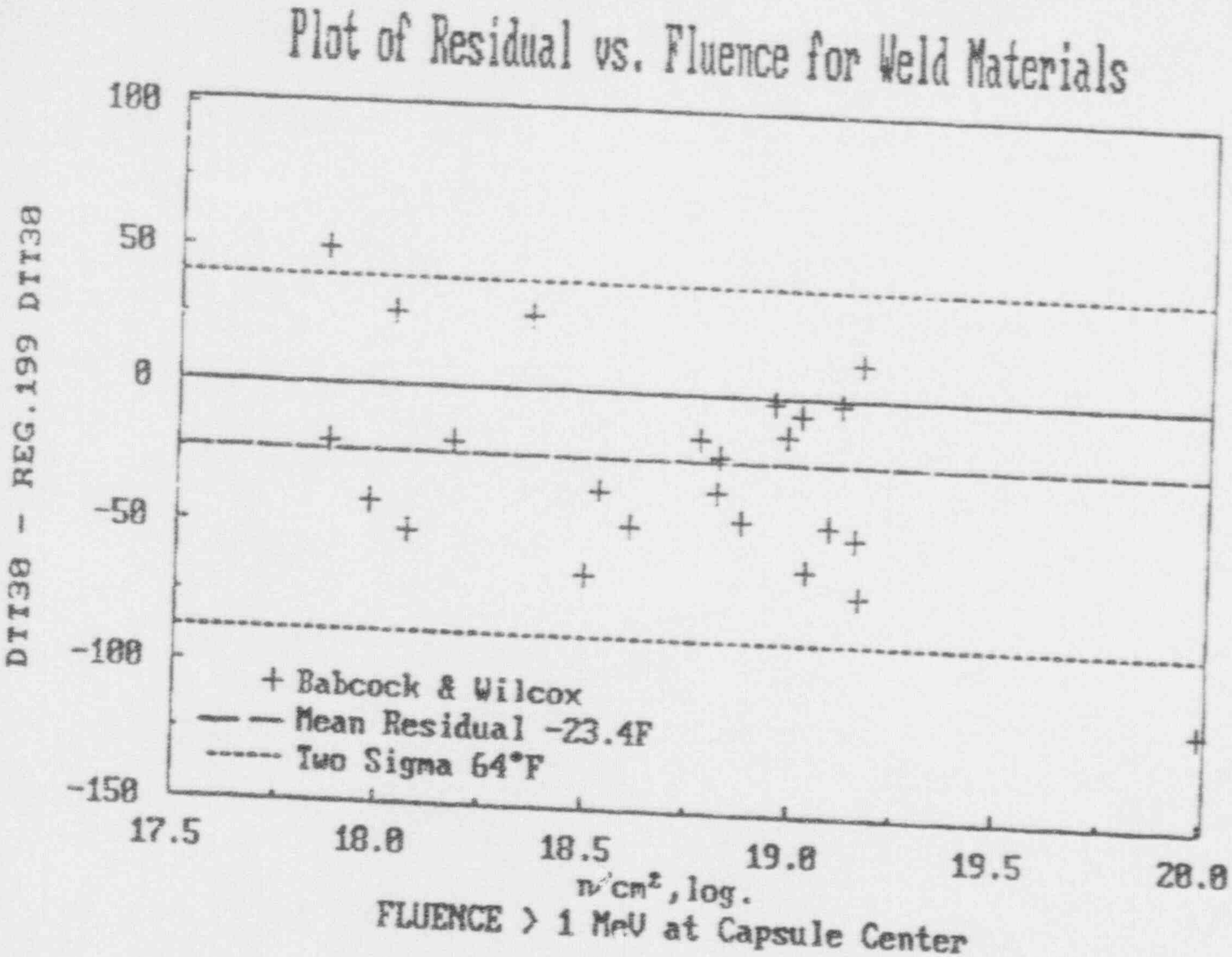

Figure 5. Plot of Residual versus Fluence for B&W Weld Materials

Residual File of Westinghouse (B&W Supplier): Page 1

TAG	PLANT_ID	CAPSULE	HEAT_ID	SPEC_ORI	CSP_FI	CAP_T_MIN	CAP_T_MAX	DT130	DT130_REG	RESIDUAL	REF_ID	CU	NI	CHEM_ID
W	AD1	V	WAD101	TL	6.580E+18		579	10	32	-22	SWRI-06-8976	0.030	0.560	WCAP-8957
W	GIN	R	WGIN01	TL	7.600E+18		579	165	151	14	BAW-1803	0.230	0.560	WCAP-10086
W	GIN	T	WGIN01	TL	1.750E+19		579	150	188	-38	WCAP-10086	0.230	0.560	WCAP-10086
W	GIN	V	WGIN01	TL	4.900E+18		579	140	131	9	FP-RA-1	0.230	0.560	WCAP-10086
W	PB1	R	WPB101	TL	2.220E+19		579	165	181	-16	WCAP-9357	0.180	0.570	WCAP-10736
W	PB1	S	WPB101	TL	7.050E+18		579	165	135	30	WCAP-8739	0.180	0.570	WCAP-10736
W	PB1	T	WPB101	TL	2.110E+19		579	180	179	1	WCAP-10736	0.180	0.570	WCAP-10736
W	PB1	V	WPB101	TL	3.580E+18	579	590	110	107	3	BMI-0673	0.180	0.570	WCAP-10736
W	PB2	R	WPB201	TL	2.010E+19		579	235	208	27	BAW-1803	0.250	0.590	WCAP-9331
W	PB2	T	WPB201	TL	9.450E+18		579	145	172	-27	WCAP-9331	0.250	0.590	WCAP-9331
W	PB2	V	WPB201	TL	4.740E+18	579	590	165	138	27	BMI-0675	0.250	0.590	WCAP-9331
W	SU1	T	WSU101	TL	2.500E+18		590	167	140	27	BAW-1803	0.350	0.680	BAW-1803
W	SU1	V	WSU101	TL	1.940E+19		579	240	264	-24	WCAP-11415	0.350	0.680	BAW-1803
W	TP3	T	WTP301	TL	5.680E+18		579	164	160	4	BAW-1803	0.310	0.540	SWRI-06-8575
W	TP3	V	WTP301	TL	1.229E+19		579	180	201	-21	SWRI-06-8575	0.310	0.540	SWRI-06-8575
W	TP4	T	WTP401		6.050E+18		579	225	167	58	SWRI-02-4221	0.300	0.600	SWRI-02-4221
W	ZN1	T	WZN101	TL	1.800E+18			112	113	-1	BAW-1803	0.350	0.570	BCL-585-4
W	ZN1	U	WZN101	TL	8.920E+18		579	199	202	-3	BAW-1803	0.350	0.570	BCL-585-4
W	ZN1	X	WZN101	TL	1.500E+19	579	590	195	232	-37	SWRI-06-7484-001	0.350	0.570	BCL-585-4
W	ZN1	Y	WZN101	TL	1.560E+19		579	205	234	-29	BAW-2082	0.350	0.570	BCL-585-4
W	ZN2	T	WZN201	LT	1.100E+19	579	590	175	214	-39	SWRI-06-6901-001	0.350	0.570	BAW-1803
W	ZN2	U	WZN201	LT	2.000E+18			145	119	26	BAW-1803	0.350	0.570	BAW-1803
W	ZN2	Y	WZN201	LT	1.480E+19		579	220	231	-11	WCAP-12396	0.350	0.570	BAW-1803

Redisual File of Westinghouse SHSS02 Materials: Page 1

TAG	PLANT_ID	CAPSULE	HEAT_ID	SPEC_ORI	CSP_F1	CAP_T_MIN	CAP_T_MAX	DTT30	DTT30_REG	RESIDUAL	REF_ID	CU	NI	CHEM_ID
W	CX1	T	SHSS02	LT	1.800E+18	579	590	60	70	-10	SWRI-02-4770	0.170	0.640	BAW-1836
W	CX1	Y	SHSS02	LT	1.200E+19	579	590	110	135	-25	SWRI-7244-001/1	0.170	0.640	BAW-1836
W	DC1	S	SHSS02	LT	2.960E+18		579	66	74	-8	WCAP-11567	0.150	0.650	WCAP-11567
W	IP3	Y	SHSS02	LT	8.050E+18		579	140	120	20	WCAP-10300	0.170	0.640	BAW-1836
W	KWE	P	SHSS02	LT	2.890E+19		579	155	164	-9	WCAP-12020	0.170	0.640	BAW-1836
W	KWE	R	SHSS02	LT	2.070E+19		579	140	153	-13	WCAP-9878	0.170	0.640	BAW-1836
W	KWE	V	SHSS02	LT	5.590E+18		579	95	107	-12	WCAP-8908	0.170	0.640	BAW-1836
W	PB2	R	SHSS02	LT	2.010E+19		579	151	152	-1	WCAP-9635	0.170	0.640	BAW-1836
W	PB2	T	SHSS02	LT	9.450E+18		579	105	126	-21	WCAP-9331	0.170	0.640	BAW-1836
W	PB2	V	SHSS02	LT	4.740E+18	579	590	90	101	-11	BMI-0675	0.170	0.640	BAW-1836
W	PI1	P	SHSS02	LT	1.250E+19			156	136	20	WCAP-10102	0.170	0.640	BAW-1836
W	PI1	R	SHSS02	LT	4.030E+19		579	186	174	12	WCAP-11006	0.170	0.640	BAW-1836
W	PI1	V	SHSS02	LT	5.210E+18		579	110	105	5	WCAP-8916	0.170	0.640	BAW-1836
W	PI2	R	SHSS02	LT	6.420E+19		579	180	176	4	WCAP-11343	0.170	0.640	BAW-1836
W	PI2	T	SHSS02	LT	1.050E+19		579	160	130	30	WCAP-9877	0.170	0.640	BAW-1836
W	PI2	V	SHSS02	LT	5.490E+18		579	125	107	18	WCAP-9212	0.170	0.640	BAW-1836
W	SA1	T	SHSS02	LT	2.560E+18		579	60	64	-4	WCAP-9678	0.140	0.680	WCAP-11955
W	SA1	Y	SHSS02	LT	8.910E+18		579	125	99	26	WCAP-10694	0.140	0.680	WCAP-11955
W	SA1	Z	SHSS02	LT	1.330E+19		579	135	110	25	WCAP-11955	0.140	0.680	WCAP-11955
W	SU1	T	SHSS02	LT	2.500E+18		590	70	80	-10	DOCKET 50-280	0.170	0.640	BAW-1836
W	SU1	V	SHSS02	LT	1.940E+19		579	145	151	-6	WCAP-11415	0.170	0.640	BAW-1836
W	SU2	V	SHSS02	LT	1.880E+19		579	120	150	-30	WCAP-11499	0.170	0.640	BAW-1836
W	SU2	X	SHSS02	LT	3.020E+18		590	60	86	-26	BMI-0975/SU2	0.170	0.640	BAW-1836
W	ZN1	T	SHSS02	LT	1.800E+18			66	70	-4	BCL-585-4	0.170	0.640	BAW-1836
W	ZN1	U	SHSS02	LT	8.920E+18		579	130	124	6	WCAP-9890	0.170	0.640	BAW-1836
W	ZN1	X	SHSS02	LT	1.400E+19	579	590	120	140	-20	SWRI-06-7484-001	0.170	0.640	BAW-1836
W	ZN1	Y	SHSS02	LT	1.560E+19		579	129	144	-15	BAW-2082	0.170	0.640	BAW-1836
W	ZN2	T	SHSS02	LT	1.000E+19	579	590	100	128	-28	SWRI-06-6901-001	0.170	0.640	BAW-1836
W	ZN2	U	SHSS02	LT	2.000E+18			50	73	-23	BCL-585-4	0.170	0.640	BAW-1836
W	ZN2	T	SHSS02	LT	1.480E+19		579	135	142	-7	WCAP-12396	0.170	0.640	BAW-1836

Residual File of Babcock & Wilcox SHSS02 Materials: Page 1

TAG	PLANT_ID	CAPSULE	HEAT_ID	SPEC_ORI	CSP_F1	CAP_T_MIN	CAP_T_MAX	DTT30	DTT30_REG	RESIDUAL	REF_ID	CU	NI	CHEM_ID
B	AN1	A	SHSS02	LT	1.030E+19	610	621	46	129	-83	BAW-1836	0.170	0.640	BAW-1836
B	AN1	B	SHSS02	LT	4.280E+18	588	610	50	98	-48	BAW-1698	0.170	0.640	BAW-1836
B	AN1	C	SHSS02	LT	1.460E+19	610	621	68	141	-73	BAW-2075/R1	0.170	0.640	BAW-1836
B	CR3	C	SHSS02	LT	6.560E+18	610	621	73	113	-40	BAW-1898	0.170	0.640	BAW-1836
B	DB1	A	SHSS02	LT	1.290E+19	610	621	106	137	-31	BAW-1882	0.170	0.640	BAW-1836
B	OC1	A	SHSS02	LT	8.950E+18	610	621	88	124	-36	BAW-1837	0.170	0.640	BAW-1836
B	OC1	C	SHSS02	LT	9.860E+19	610	621	68	194	-126	BAW-2050	0.170	0.640	BAW-1836
B	OC2	A	SHSS02	LT	3.370E+18	610	621	71	90	-19	BAW-1699	0.170	0.640	BAW-1836
B	OC2	E	SHSS02	LT	1.210E+19	621		95	135	-40	BAW-2051	0.170	0.640	BAW-1836
B	OC3	B	SHSS02	LT	3.120E+18	588	610	39	87	-48	BAW-1697	0.170	0.640	BAW-1836
B	OC3	D	SHSS02	LT	1.450E+19	610	621	119	141	-22	BAW-2128	0.170	0.640	BAW-1836
B	TMI	C	SHSS02	LT	8.660E+18			77	123	-46	BAW-1901	0.17	0.64	BAW-1836