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MFN 06-260 Supplement 2

Docket No. 52-010

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U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 41 - Reactor Pressure Vessel and Nuclear Boiler System - RAI Number 5.2-38 S01**

Enclosure 1 contains GE's response to the subject NRC RAI originally transmitted via the Reference 1 letter and supplemented by NRC request for clarification. Enclosure 2 contains a report prepared to support this response.

If you have any questions or require additional information, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

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MRO

Reference:

1. MFN 06-220, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 41 Related to ESBWR Design Certification Application*, July 10, 2006

Enclosures:

1. MFN 06-260 Supplement 2 - Response to Portion of NRC Request for Additional Information Letter No. 41 - Related to ESBWR Design Certification Application - Reactor Pressure Vessel and Nuclear Boiler System - RAI Number 5.2-38 S01
2. MFN 06-260 Supplement 2 - RAI Number 5.2-38 S01 - Evaluation of Statistical Equivalency Between ASTM A800 and Hull Methods

cc:	AE Cubbage	USNRC (with enclosures)
	BE Brown	GE/Wilmington (with enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	eDRF	0000-0068-0101
		0000-0063-9694R1

Enclosure 1

MFN 06-260 Supplement 2

Response to Portion of NRC Request for

Additional Information Letter No. 41

Related to ESBWR Design Certification Application

Reactor Pressure Vessel and Nuclear Boiler System

RAI Number 5.2-38 S01

NRC RAI 5.2-38:

Given that cast austenitic stainless steel (CASS) can be susceptible to thermal aging embrittlement, please discuss the following for any CASS component that acts as a RCPB: (1) the impact of this aging effect on the integrity of the components, (2) the consideration of the thermal embrittlement mechanism in the design and material selection for RCPB components, (3) the need for inspections to detect this aging effect, and (4) verify that ä-ferrite content is calculated using Hull's equivalent factors or a method producing an equivalent level of accuracy.

GE Response:

See GE response to RAI 4.5-3 with respect to performance of cast stainless steel in the BWR environment and control of ferrite and carbon content as a means to control thermal embrittlement of cast austenitic stainless steel. (1) As described in RAI Response 4.5-3, there is virtually no thermal aging of cast stainless steel at BWR operating temperatures (288°C maximum) for Grades CF3/CF3A when ferrite content is limited to 20% maximum. (2) and (3) Consideration of these items is not necessary based on Item (1) response. (4) Delta ferrite will be determined in accordance with ASTM A800, which is considered to have adequate accuracy.

NRC RAI 5.2-38 S01:

In GE's response to RAI 5.2-38 (MFN 06-260), GE indicated that it will use ASTM A800 in lieu of Hull's equivalent factors. The staff's position is that percent ferrite is calculated using Hull's equivalent factors as indicated in NUREG/CR-4513, Rev.1 (May 1994). NUREG/CR-4513, Rev.1, states that ASTM A800 may produce lower ferrite numbers than Hull's equivalent factors for materials with greater than 12% ferrite. In response to RAI 6.1-15 (MFN 06-365) GE stated that, It is agreed that the A800 method tends to predict somewhat lower values at higher ferrite levels than the Hull's equivalent method. However, when the two methods are compared to the corresponding measured values reported in the NUREG using rigorous statistical analysis, it can be demonstrated the two methods are equally accurate. Provide the rigorous statistical analysis that shows that the method to calculate ferrite in ASTM A800 and Hull's equivalent factors are equally accurate.

GE Response:

The statistical equivalency of the accuracy of the two methods is demonstrated in Enclosure 2, "MFN 06-260 Supplement 1 - RAI Number 5.2-38 S01 - Evaluation of Statistical Equivalency Between ASTM A800 and Hull Methods."

DCD Impact:

No DCD changes will be made in response to this RAI.

Enclosure 2

MFN 06-260 Supplement 2

RAI Number 5.2-38 S01

Evaluation of Statistical Equivalency Between ASTM A800 and Hull Methods

Evaluation of Statistical Equivalency Between ASTM A800 and Hull Methods

Global Nuclear Fuel Material Evaluation

Comparison of the ASTM A800 and Hull Methods for Ferrite Concentrations
C. Patterson 26 January 2007

Description

Estimates of ferrite concentrations by the ASTM A800 and Hull methods were compared with the corresponding measured values. Data for this comparison were extracted from Table 1 of NUREG/CR-4513 [1]. Given that the ferrite for austenitic stainless steel castings is limited to 20% for high temperature applications, the comparison considered material with ferrite concentrations of ≤ 25%. The estimates for both methods are shown relative to the measured values in Figure 1. The comparisons were performed by means of the MINITAB [2] computer program and, separately, by the statistical functions in the Excel [3] program. The results of regression analyses relating the combined set of predictions and measurements are also included in Figure 1. The predictions of both methods exhibit scatter which increases with ferrite content. The predictions also appear to drift below the measured values with increasing concentration. As shown below, however, the methods appear to agree relatively well with each other and with the measurements.

The relative agreement of predictions by the ASTM A800 and Hull methods was assessed by means of the residual difference between the predictions and the corresponding values from the regression equation; viz.,

$$(Residual)_{iobs}^{jmethod} = (Predicted)_{iobs}^{jmethod} - a(Measured)_{iobs} \quad (1)$$

where "a" is the regression coefficient, "iobs" represent corresponding predictions and measurements and "jmethod" refers to either the ASTM A800 or Hull method. As shown in Figure 2, the distribution of residuals is approximately Normal with no apparent difference between the ASTM A800 and Hull estimates. The results of a test for homogeneity of variance between the residuals from the two methods and of test of the equality of means are shown in Figure 3.

The conclusion is that the predictions of the two methods agree equally well with the measured values.

References

1. O.K. Chopra, "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems", NUREG/CR-4513, May 1994.
2. MINITAB, Release 12.23, Minitab, State College, PA.
3. Excel, 9.0.8950 SP-3, Microsoft, Redmond, WA.

Figure 1

Ferrite Concentrations Predicted by A800 and Hull Methods Relative to Measured Values

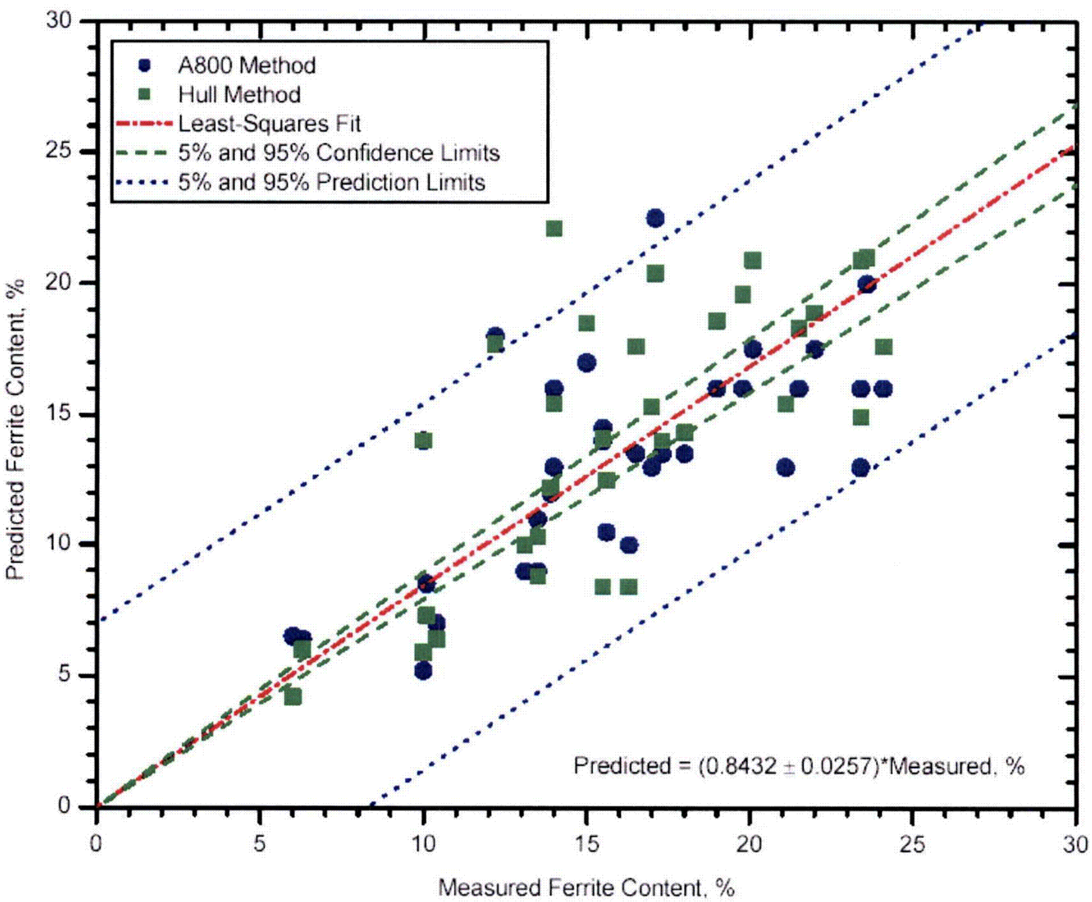


Figure 2

Distribution of Residuals from Pooled Fit of Predicted and Measured Ferrite Concentrations

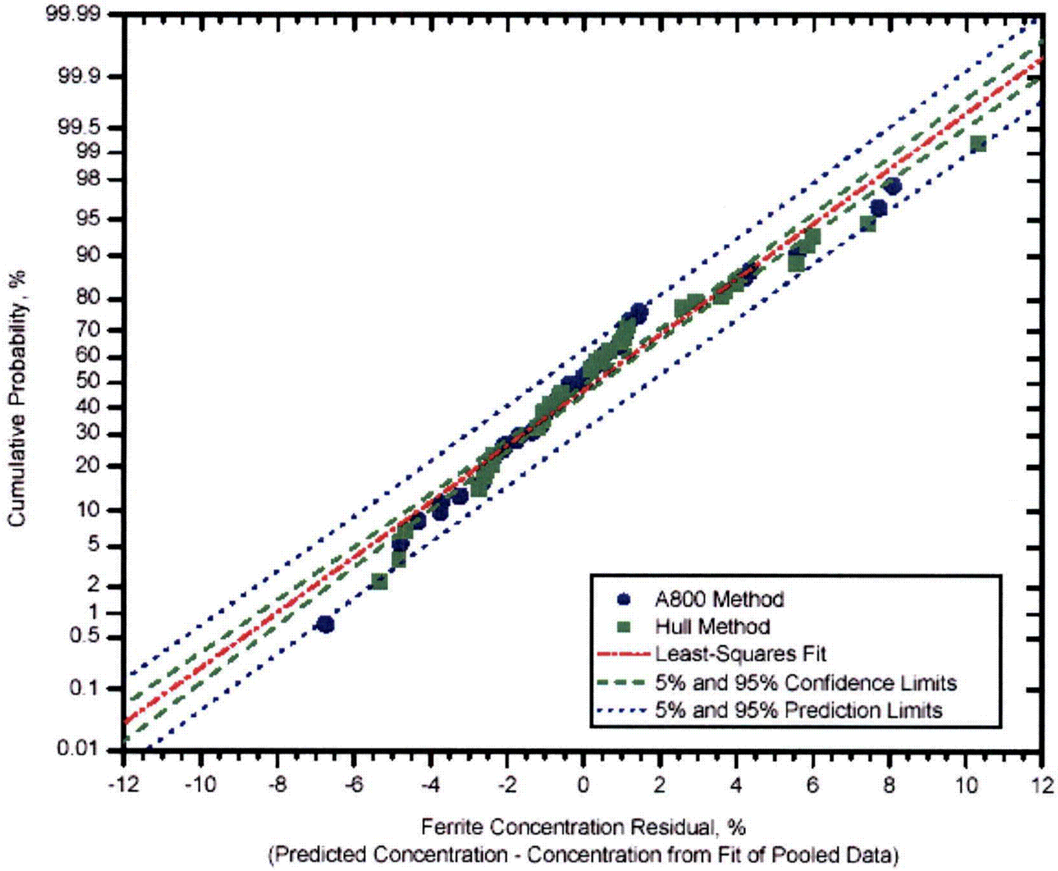
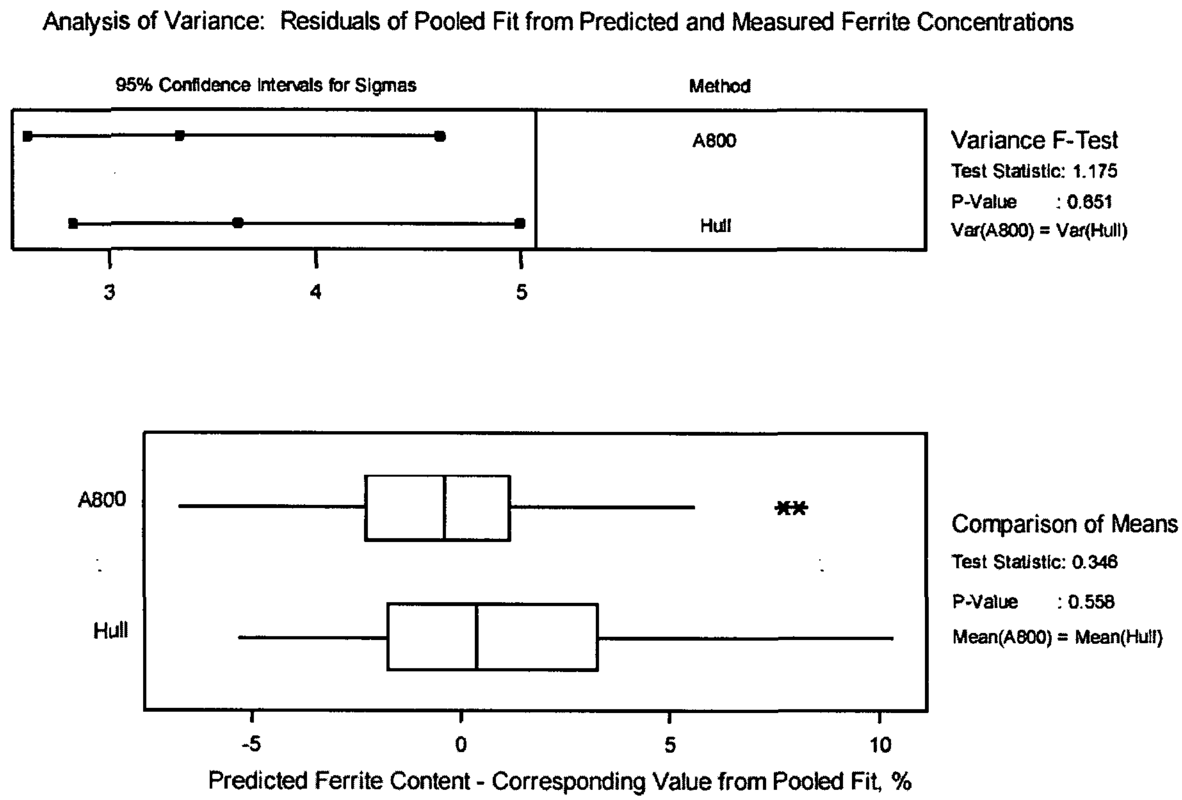


Figure 3

Analysis of Residuals from Pooled Fit of Predicted and Measured Ferrite Concentrations



Data Source: NUREG CR-4513 Revision 1 - Table 1

Source	Heat	Cr	Mo	Si	Ni	Mn	C	N	Cr Equiv	Ni Equiv	Ratio	A800 est	Hull est	Meas
Argonne	52	19.49	0.35	0.92	9.4	0.57	0.009	0.052	16.37	13.56	1.21	11	10.3	13.5
Argonne	51	20.13	0.32	0.86	9.06	0.63	0.01	0.058	16.88	13.43	1.26	13.5	14.3	18
Argonne	47	19.81	0.59	1.06	10.63	0.6	0.018	0.028	17.24	14.45	1.19	10	8.4	16.3
Argonne	P2	20.2	0.16	0.64	9.38	0.74	0.019	0.04	16.39	13.61	1.20	10.5	12.5	15.6
Argonne	I	20.2	0.45	0.83	8.07	0.47	0.019	0.032	17.09	11.96	1.43	22.5	20.4	17.1
Argonne	69	20.18	0.34	1.13	8.59	0.63	0.023	0.028	17.36	12.57	1.38	20	21	23.6
Argonne	P1	20.49	0.04	1.12	8.1	0.59	0.036	0.057	17.24	13.21	1.31	16	17.6	24.1
Argonne	61	20.65	0.32	1.01	8.86	0.65	0.054	0.08	17.62	15.14	1.16	9	10	13.1
Argonne	59	20.33	0.32	1.08	9.34	0.6	0.062	0.045	17.41	14.92	1.17	9	8.8	13.5
Argonne	68	20.64	0.31	1.07	8.08	0.64	0.063	0.062	17.69	14.15	1.25	13	14.9	23.4
Argonne	60	21.05	0.31	0.95	8.34	0.67	0.064	0.058	17.92	14.35	1.25	13	15.4	21.1
Argonne	56	19.65	0.34	1.05	9.28	0.57	0.066	0.03	16.71	14.58	1.15	8.5	7.3	10.1
Argonne	74	19.11	2.51	0.73	9.03	0.54	0.064	0.048	18.73	14.72	1.27	14	8.4	15.5
Argonne	75	20.86	2.58	0.67	9.12	0.53	0.065	0.052	20.49	14.94	1.37	19	24.8	27.8
Argonne	66	19.45	2.39	0.49	9.28	0.6	0.047	0.029	18.54	13.99	1.32	16	19.6	19.8
Argonne	64	20.76	2.46	0.63	9.4	0.6	0.038	0.038	20.16	14.08	1.43	22.5	29	28.4
Argonne	65	20.78	2.57	0.48	9.63	0.5	0.049	0.064	20.11	15.26	1.32	16	20.9	23.4
Argonne	P4	19.64	2.05	1.02	10	1.07	0.04	0.151	19.05	17.91	1.06	5.2	5.9	10
Argonne	63	19.37	2.57	0.58	11.85	0.61	0.055	0.031	18.85	16.86	1.12	7	6.4	10.4
GeorgFischer	284	23	0.17	0.52	8.23	0.28	0.025	0.037	19.03	12.33	1.54	31	43.6	42
GeorgFischer	280	21.6	0.25	1.37	8	0.5	0.028	0.038	19.02	12.33	1.54	31	36.3	38
GeorgFischer	282	22.5	0.15	0.35	8.53	0.43	0.035	0.04	18.25	13.09	1.39	20	29.7	38
GeorgFischer	281	23.1	0.17	0.45	8.6	0.41	0.036	0.053	19.02	13.51	1.41	21	31.4	30
GeorgFischer	283	22.6	0.23	0.53	7.88	0.48	0.036	0.032	18.73	12.28	1.52	29	42.6	42
GeorgFischer	278	20.2	0.13	1	8.27	0.28	0.038	0.03	16.89	12.58	1.34	17	18.5	15
GeorgFischer	279	22	0.22	1.36	7.85	0.37	0.04	0.032	19.36	12.32	1.57	33.5	39.5	40
GeorgFischer	277	20.5	0.06	1.81	8.13	0.54	0.052	0.019	18.31	12.70	1.44	23.5	22.5	28
GeorgFischer	291	19.6	0.66	1.59	10.6	0.28	0.065	0.054	17.92	16.34	1.10	6.5	4.2	6
GeorgFischer	292	21.6	0.13	1.57	7.52	0.34	0.09	0.039	19.15	13.65	1.40	21	23.9	28
GeorgFischer	290	20	2.4	1.51	8.3	0.41	0.054	0.05	20.64	13.68	1.51	28.5	31.3	32

Data Source: NUREG CR-4513 Revision 1 - Table 1

Source	Heat	Cr	Mo	Si	Ni	Mn	C	N	Cr Equiv	Ni Equiv	Ratio	A800 est	Hull est	Meas
GeorgFischer	288	19.6	2.53	1.7	8.4	0.47	0.052	0.022	20.70	13.02	1.59	35.5	35.6	28
GeorgFischer	287	20.5	2.58	0.51	8.46	0.5	0.047	0.033	19.89	13.23	1.50	28	37.2	38
GeorgFischer	286	20.2	2.44	1.33	9.13	0.4	0.072	0.062	20.62	15.35	1.34	17.5	18.9	22
GeorgFischer	289	19.7	2.3	1.44	8.25	0.48	0.091	0.032	20.09	14.30	1.40	21	22.6	30
GeorgFischer	285	18.8	2.35	0.86	9.49	0.48	0.047	0.039	18.39	14.40	1.28	14	14	10
Framatomme	A	18.9	0.1	0.99	8.9	1.14	0.021	0.074	15.54	14.27	1.09	6.4	6	6.3
Framatomme	E	21.04	0.08	0.54	8.47	0.8	0.035	0.051	16.97	13.50	1.26	13.5	17.6	16.5
Framatomme	F	19.72	0.34	1.16	8.33	0.26	0.038	0.026	16.95	12.53	1.35	18	17.7	12.2
Framatomme	C	20.73	0.13	1.09	8.19	0.91	0.042	0.035	17.56	13.07	1.34	17.5	20.9	20.1
Framatomme	G	20.65	0.02	1.03	8.08	0.74	0.04	0.073	17.23	13.80	1.25	13	15.3	17
Framatomme	H	20.7	0.05	1.18	8.07	0.71	0.05	0.045	17.55	13.35	1.32	16	18.3	21.5
Framatomme	D	19.15	2.5	0.94	10.32	1.12	0.026	0.063	19.07	15.55	1.23	12	12.2	13.9
Framatomme	I	19.36	2.4	0.98	10.69	0.7	0.02	0.039	19.20	14.90	1.29	14.5	14.1	15.5
Framatomme	K	20.8	2.62	0.75	10.45	1.09	0.06	0.056	20.60	16.50	1.25	13	15.4	14
Framatomme	L	20.76	2.48	0.81	10.56	0.79	0.04	0.042	20.46	15.50	1.32	16	18.6	19
Framatomme	B	20.12	2.52	0.93	10.56	0.83	0.053	0.042	20.05	15.91	1.26	13.5	14	17.3
Westinghouse	C1488	20.95	2.63	0.53	9.48	1.02	0.061	0.056	20.44	15.53	1.32	16	22.1	14
EPRI	EPRI	22.04	0.23	0.84	7.93	0.74	0.03	0.045	18.63	12.62	1.48	26	36	32

Data Source: NUREG CR-4513 Revision 1 - Table 1
Data With Up To 25% Ferrite

Source	Heat #	Cr	Mo	Si	Ni	Mn	C	N	Cr Equiv	Ni Equiv	Ratio	A800 est	Hull est	Meas	A - Meas	H - Meas	(A - M)/M	(H - M)/M
Argonne	52	19.49	0.35	0.92	9.4	0.57	0.009	0.052	16.37	13.56	1.21	11	10.3	13.5	-2.5	-3.2	-18.5185	-23.7037
Argonne	51	20.13	0.32	0.86	9.06	0.63	0.01	0.058	16.88	13.43	1.26	13.5	14.3	18	-4.5	-3.7	-25	-20.5556
Argonne	47	19.81	0.59	1.06	10.63	0.6	0.018	0.028	17.24	14.45	1.19	10	8.4	16.3	-6.3	-7.9	-38.6503	-48.4663
Argonne	P2	20.2	0.16	0.64	9.38	0.74	0.019	0.04	16.39	13.61	1.20	10.5	12.5	15.6	-5.1	-3.1	-32.6923	-19.8718
Argonne	I	20.2	0.45	0.83	8.07	0.47	0.019	0.032	17.09	11.96	1.43	22.5	20.4	17.1	5.4	3.3	31.57895	19.29825
Argonne	69	20.18	0.34	1.13	8.59	0.63	0.023	0.028	17.36	12.57	1.38	20	21	23.6	-3.6	-2.6	-15.2542	-11.0169
Argonne	P1	20.49	0.04	1.12	8.1	0.59	0.036	0.057	17.24	13.21	1.31	16	17.6	24.1	-8.1	-6.5	-33.61	-26.971
Argonne	61	20.65	0.32	1.01	8.86	0.65	0.054	0.08	17.62	15.14	1.16	9	10	13.1	-4.1	-3.1	-31.2977	-23.6641
Argonne	59	20.33	0.32	1.08	9.34	0.6	0.062	0.045	17.41	14.92	1.17	9	8.8	13.5	-4.5	-4.7	-33.3333	-34.8148
Argonne	68	20.64	0.31	1.07	8.08	0.64	0.063	0.062	17.69	14.15	1.25	13	14.9	23.4	-10.4	-8.5	-44.4444	-36.3248
Argonne	60	21.05	0.31	0.95	8.34	0.67	0.064	0.058	17.92	14.35	1.25	13	15.4	21.1	-8.1	-5.7	-38.3886	-27.0142
Argonne	56	19.65	0.34	1.05	9.28	0.57	0.066	0.03	16.71	14.58	1.15	8.5	7.3	10.1	-1.6	-2.8	-15.8416	-27.7228
Argonne	74	19.11	2.51	0.73	9.03	0.54	0.064	0.048	18.73	14.72	1.27	14	8.4	15.5	-1.5	-7.1	-9.67742	-45.8065
Argonne	66	19.45	2.39	0.49	9.28	0.6	0.047	0.029	18.54	13.99	1.32	16	19.6	19.8	-3.8	-0.2	-19.1919	-1.0101
Argonne	65	20.78	2.57	0.48	9.63	0.5	0.049	0.064	20.11	15.26	1.32	16	20.9	23.4	-7.4	-2.5	-31.6239	-10.6838
Argonne	P4	19.64	2.05	1.02	10	1.07	0.04	0.151	19.05	17.91	1.06	5.2	5.9	10	-4.8	-4.1	-48	-41
Argonne	63	19.37	2.57	0.58	11.85	0.61	0.055	0.031	18.85	16.86	1.12	7	6.4	10.4	-3.4	-4	-32.6923	-38.4615
GeorgFischer	278	20.2	0.13	1	8.27	0.28	0.038	0.03	16.89	12.58	1.34	17	18.5	15	2	3.5	13.33333	23.33333
GeorgFischer	291	19.6	0.66	1.59	10.6	0.28	0.065	0.054	17.92	16.34	1.10	6.5	4.2	6	0.5	-1.8	8.333333	-30
GeorgFischer	286	20.2	2.44	1.33	9.13	0.4	0.072	0.062	20.62	15.35	1.34	17.5	18.9	22	-4.5	-3.1	-20.4545	-14.0909
GeorgFischer	285	18.8	2.35	0.86	9.49	0.48	0.047	0.039	18.39	14.40	1.28	14	14	10	4	4	40	40
Framatomme	A	18.9	0.1	0.99	8.9	1.14	0.021	0.074	15.54	14.27	1.09	6.4	6	6.3	0.1	-0.3	1.587302	-4.7619
Framatomme	E	21.04	0.08	0.54	8.47	0.8	0.035	0.051	16.97	13.50	1.26	13.5	17.6	16.5	-3	1.1	-18.1818	6.666667
Framatomme	F	19.72	0.34	1.16	8.33	0.26	0.038	0.026	16.95	12.53	1.35	18	17.7	12.2	5.8	5.5	47.54098	45.08197
Framatomme	C	20.73	0.13	1.09	8.19	0.91	0.042	0.035	17.56	13.07	1.34	17.5	20.9	20.1	-2.6	0.8	-12.9353	3.9801
Framatomme	G	20.65	0.02	1.03	8.08	0.74	0.04	0.073	17.23	13.80	1.25	13	15.3	17	-4	-1.7	-23.5294	-10
Framatomme	H	20.7	0.05	1.18	8.07	0.71	0.05	0.045	17.55	13.35	1.32	16	18.3	21.5	-5.5	-3.2	-25.5814	-14.8837
Framatomme	D	19.15	2.5	0.94	10.32	1.12	0.026	0.063	19.07	15.55	1.23	12	12.2	13.9	-1.9	-1.7	-13.6691	-12.2302
Framatomme	I	19.36	2.4	0.98	10.69	0.7	0.02	0.039	19.20	14.90	1.29	14.5	14.1	15.5	-1	-1.4	-6.45161	-9.03226

Data Source: NUREG CR-4513 Revision 1 - Table 1
Data With Up To 25% Ferrite

Source	Heat #	Cr	Mo	Si	Ni	Mn	C	N	Cr Equiv	Ni Equiv	Ratio	A800 est	Hull est	Meas	A - Meas	H - Meas	(A - M)/M	(H - M)/M
Framatomme	K	20.8	2.62	0.75	10.45	1.09	0.06	0.056	20.60	16.50	1.25	13	15.4	14	-1	1.4	-7.14286	10
Framatomme	L	20.76	2.48	0.81	10.56	0.79	0.04	0.042	20.46	15.50	1.32	16	18.6	19	-3	-0.4	-15.7895	-2.10526
Framatomme	B	20.12	2.52	0.93	10.56	0.83	0.053	0.042	20.05	15.91	1.26	13.5	14	17.3	-3.8	-3.3	-21.9653	-19.0751
Westinghouse	C1488	20.95	2.63	0.53	9.48	1.02	0.061	0.056	20.44	15.53	1.32	16	22.1	14	2	8.1	14.28571	57.85714
nobs =															33	33	33	33
avg =															-2.73333	-1.78485	-14.4624	-10.5167
stdev =															3.716657	3.768299	23.09144	25.61129

	Nobs =	66
	dProb =	1.515152
PMethod	P - M	ProbPM
Hull	8.1	99.24242
A800	5.8	97.72727
Hull	5.5	96.21212
A800	5.4	94.69697
A800	4	93.18182
Hull	4	91.66667
Hull	3.5	90.15152
Hull	3.3	88.63636
A800	2	87.12121
A800	2	85.60606
Hull	1.4	84.09091
Hull	1.1	82.57576
Hull	0.8	81.06061
A800	0.5	79.54545
A800	0.1	78.0303
Hull	-0.2	76.51515
Hull	-0.3	75
Hull	-0.4	73.48485
A800	-1	71.9697
A800	-1	70.45455
Hull	-1.4	68.93939
A800	-1.5	67.42424
A800	-1.6	65.90909
Hull	-1.7	64.39394
Hull	-1.7	62.87879
Hull	-1.8	61.36364
A800	-1.9	59.84848
A800	-2.5	58.33333
Hull	-2.5	56.81818
A800	-2.6	55.30303
Hull	-2.6	53.78788
Hull	-2.8	52.27273
A800	-3	50.75758
A800	-3	49.24242
Hull	-3.1	47.72727
Hull	-3.1	46.21212
Hull	-3.1	44.69697
Hull	-3.2	43.18182
Hull	-3.2	41.66667
Hull	-3.3	40.15152
A800	-3.4	38.63636
A800	-3.6	37.12121
Hull	-3.7	35.60606

	Nobs =	66
	dProb =	1.515152
PMethod	P - M	ProbPM
A800	-3.8	34.09091
A800	-3.8	32.57576
A800	-4	31.06061
Hull	-4	29.54545
A800	-4.1	28.0303
Hull	-4.1	26.51515
A800	-4.5	25
A800	-4.5	23.48485
A800	-4.5	21.9697
Hull	-4.7	20.45455
A800	-4.8	18.93939
A800	-5.1	17.42424
A800	-5.5	15.90909
Hull	-5.7	14.39394
A800	-6.3	12.87879
Hull	-6.5	11.36364
Hull	-7.1	9.848485
A800	-7.4	8.333333
Hull	-7.9	6.818182
A800	-8.1	5.30303
A800	-8.1	3.787879
Hull	-8.5	2.272727
A800	-10.4	0.757576

	Nobs =	66
	dProb =	1.515152
Method	PMrel	Probrel
Hull	57.85714	99.24242
A800	47.54098	97.72727
Hull	45.08197	96.21212
A800	40	94.69697
Hull	40	93.18182
A800	31.57895	91.66667
Hull	23.33333	90.15152
Hull	19.29825	88.63636
A800	14.28571	87.12121
A800	13.33333	85.60606
Hull	10	84.09091
A800	8.333333	82.57576
Hull	6.666667	81.06061
Hull	3.9801	79.54545
A800	1.587302	78.0303
Hull	-1.0101	76.51515
Hull	-2.10526	75
Hull	-4.7619	73.48485
A800	-6.45161	71.9697
A800	-7.14286	70.45455
Hull	-9.03226	68.93939
A800	-9.67742	67.42424
Hull	-10	65.90909
Hull	-10.6838	64.39394
Hull	-11.0169	62.87879
Hull	-12.2302	61.36364
A800	-12.9353	59.84848
A800	-13.6691	58.33333
Hull	-14.0909	56.81818
Hull	-14.8837	55.30303
A800	-15.2542	53.78788
A800	-15.7895	52.27273
A800	-15.8416	50.75758
A800	-18.1818	49.24242
A800	-18.5185	47.72727
Hull	-19.0751	46.21212
A800	-19.1919	44.69697
Hull	-19.8718	43.18182
A800	-20.4545	41.66667
Hull	-20.5556	40.15152
A800	-21.9653	38.63636
A800	-23.5294	37.12121
Hull	-23.6641	35.60606

	Nobs =	66
	dProb =	1.515152
Method	PMrel	Probrel
Hull	-23.7037	34.09091
A800	-25	32.57576
A800	-25.5814	31.06061
Hull	-26.971	29.54545
Hull	-27.0142	28.0303
Hull	-27.7228	26.51515
Hull	-30	25
A800	-31.2977	23.48485
A800	-31.6239	21.9697
A800	-32.6923	20.45455
A800	-32.6923	18.93939
A800	-33.3333	17.42424
A800	-33.61	15.90909
Hull	-34.8148	14.39394
Hull	-36.3248	12.87879
A800	-38.3886	11.36364
Hull	-38.4615	9.848485
A800	-38.6503	8.333333
Hull	-41	6.818182
A800	-44.4444	5.30303
Hull	-45.8065	3.787879
A800	-48	2.272727
Hull	-48.4663	0.757576

Method	MeasAll	PredAll	Resid1All	Resid2All
a800	13.5	11	-0.38267289	-1.085935501
a800	18	13.5	-1.67689719	-1.579495862
a800	16.3	10	-3.74352357	-3.948595281
a800	15.6	10.5	-2.6533109	-2.982930336
a800	17.1	22.5	8.081947671	8.01921621
a800	23.6	20	0.101401464	1.195184578
a800	24.1	16	-4.32017901	-3.13743324
a800	13.1	9	-2.04540851	-2.819841247
a800	13.5	9	-2.38267289	-3.085935501
a800	23.4	13	-6.72996634	-5.671768295
a800	21.1	13	-4.79069615	-4.141726333
a800	10.1	8.5	-0.01592564	-1.32413434
a800	15.5	14	0.931005199	0.583593227
a800	19.8	16	-0.69458691	-0.276920006
a800	23.4	16	-3.72996634	-2.671768295
a800	10	5.2	-3.23160955	-4.557610777
a800	10.4	7	-1.76887393	-3.023705031
a800	15	17	4.352585676	3.916211045
a800	6	6.5	1.441034271	-0.596668234
a800	22	17.5	-1.04954101	-0.240438405
a800	10	14	5.568390451	4.242389223
a800	6.3	6.4	1.088085984	-0.896238925
a800	16.5	13.5	-0.41215576	-0.581642408
a800	12.2	18	7.71343635	6.778870825
a800	20.1	17.5	0.552464806	1.023509303
a800	17	13	-1.33373623	-1.414260226
a800	21.5	16	-2.12796053	-1.407820587
a800	13.9	12	0.280062727	-0.352029756
a800	15.5	14.5	1.431005199	1.083593227
a800	14	13	1.195746631	0.581446681
a800	19	16	-0.02005814	0.255268502
a800	17.3	13.5	-1.08668452	-1.113830917
a800	14	16	4.195746631	3.581446681
hull	13.5	10.3	-1.08267289	-1.785935501
hull	18	14.3	-0.87689719	-0.779495862
hull	16.3	8.4	-5.34352357	-5.548595281
hull	15.6	12.5	-0.6533109	-0.982930336
hull	17.1	20.4	5.981947671	5.91921621
hull	23.6	21	1.101401464	2.195184578
hull	24.1	17.6	-2.72017901	-1.53743324
hull	13.1	10	-1.04540851	-1.819841247
hull	13.5	8.8	-2.58267289	-3.285935501
hull	23.4	14.9	-4.82996634	-3.771768295
hull	21.1	15.4	-2.39069615	-1.741726333
hull	10.1	7.3	-1.21592564	-2.52413434

Method	MeasAll	PredAll	Resid1All	Resid2All
hull	15.5	8.4	-4.6689948	-5.016406773
hull	19.8	19.6	2.905413093	3.323079994
hull	23.4	20.9	1.170033655	2.228231705
hull	10	5.9	-2.53160955	-3.857610777
hull	10.4	6.4	-2.36887393	-3.623705031
hull	15	18.5	5.852585676	5.416211045
hull	6	4.2	-0.85896573	-2.896668234
hull	22	18.9	0.350458992	1.159561595
hull	10	14	5.568390451	4.242389223
hull	6.3	6	0.688085984	-1.296238925
hull	16.5	17.6	3.687844244	3.518357592
hull	12.2	17.7	7.41343635	6.478870825
hull	20.1	20.9	3.952464806	4.423509303
hull	17	15.3	0.966263767	0.885739774
hull	21.5	18.3	0.172039469	0.892179413
hull	13.9	12.2	0.480062727	-0.152029756
hull	15.5	14.1	1.031005199	0.683593227
hull	14	15.4	3.595746631	2.981446681
hull	19	18.6	2.579941857	2.855268502
hull	17.3	14	-0.58668452	-0.613830917
hull	14	22.1	10.29574663	9.681446681
avg =			0.254135971	2.69145E-16
stdev =			3.485822856	3.37864499
avg(a800) =			-0.22010645	-0.474242424
stdev(a800) =			3.336723082	3.082123658
avg(hull) =			0.728378395	0.474242424
stdev(hull) =			3.617188162	3.636461967

SUMMARY OUTPUT: Pred = a + b*Meas

Regression Statistics	
Multiple R	0.688438957
R Square	0.473948197
Adjusted R Square	0.465728637
Standard Error	3.404938344
Observations	66

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	668.4991204	668.4991204	57.66102202	1.67947E-10
Residual	64	741.9907281	11.59360513		
Total	65	1410.489848			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	3.10525442	1.46505122	2.119553485	0.03792805	0.178480796	6.032028044
Meas	0.665235636	0.087606098	7.593485499	1.67947E-10	0.490222494	0.840248778

SUMMARY OUTPUT: Pred = b*Meas

Regression Statistics	
Multiple R	0.66107622
R Square	0.437021769
Adjusted R Square	0.421637153
Standard Error	3.495216687
Observations	66

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	616.4147685	616.4147685	50.45739498	1.22512E-09
Residual	65	794.07508	12.21653969		
Total	66	1410.489848			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A
MeasAll	0.843160955	0.025726675	32.7738016	3.86661E-42	0.791781268	0.894540642

	nobs =	66		nobs =	66
	dP =	1.515152		dP =	1.515152
Method1	Resid1All	Prob1All	Method2	Resid2All	Prob2All
hull	10.29575	99.24242	hull	9.681447	99.24242
a800	8.081948	97.72727	a800	8.019216	97.72727
a800	7.713436	96.21212	a800	6.778871	96.21212
hull	7.413436	94.69697	hull	6.478871	94.69697
hull	5.981948	93.18182	hull	5.919216	93.18182
hull	5.852586	91.66667	hull	5.416211	91.66667
a800	5.56839	90.15152	hull	4.423509	90.15152
hull	5.56839	88.63636	a800	4.242389	88.63636
a800	4.352586	87.12121	hull	4.242389	87.12121
a800	4.195747	85.60606	a800	3.916211	85.60606
hull	3.952465	84.09091	a800	3.581447	84.09091
hull	3.687844	82.57576	hull	3.518358	82.57576
hull	3.595747	81.06061	hull	3.32308	81.06061
hull	2.905413	79.54545	hull	2.981447	79.54545
hull	2.579942	78.0303	hull	2.855269	78.0303
a800	1.441034	76.51515	hull	2.228232	76.51515
a800	1.431005	75	hull	2.195185	75
a800	1.195747	73.48485	a800	1.195185	73.48485
hull	1.170034	71.9697	hull	1.159562	71.9697
hull	1.101401	70.45455	a800	1.083593	70.45455
a800	1.088086	68.93939	a800	1.023509	68.93939
hull	1.031005	67.42424	hull	0.892179	67.42424
hull	0.966264	65.90909	hull	0.88574	65.90909
a800	0.931005	64.39394	hull	0.683593	64.39394
hull	0.688086	62.87879	a800	0.583593	62.87879
a800	0.552465	61.36364	a800	0.581447	61.36364
hull	0.480063	59.84848	a800	0.255269	59.84848
hull	0.350459	58.33333	hull	-0.15203	58.33333
a800	0.280063	56.81818	a800	-0.24044	56.81818
hull	0.172039	55.30303	a800	-0.27692	55.30303
a800	0.101401	53.78788	a800	-0.35203	53.78788
a800	-0.01593	52.27273	a800	-0.58164	52.27273
a800	-0.02006	50.75758	a800	-0.59667	50.75758
a800	-0.38267	49.24242	hull	-0.61383	49.24242
a800	-0.41216	47.72727	hull	-0.7795	47.72727
hull	-0.58668	46.21212	a800	-0.89624	46.21212
hull	-0.65331	44.69697	hull	-0.98293	44.69697
a800	-0.69459	43.18182	a800	-1.08594	43.18182
hull	-0.85897	41.66667	a800	-1.11383	41.66667
hull	-0.8769	40.15152	hull	-1.29624	40.15152
hull	-1.04541	38.63636	a800	-1.32413	38.63636
a800	-1.04954	37.12121	a800	-1.40782	37.12121
hull	-1.08267	35.60606	a800	-1.41426	35.60606

	nobs =	66		nobs =	66
	dP =	1.515152		dP =	1.515152
Method1	Resid1All	Prob1All	Method2	Resid2All	Prob2All
a800	-1.08668	34.09091	hull	-1.53743	34.09091
hull	-1.21593	32.57576	a800	-1.5795	32.57576
a800	-1.33374	31.06061	hull	-1.74173	31.06061
a800	-1.6769	29.54545	hull	-1.78594	29.54545
a800	-1.76887	28.0303	hull	-1.81984	28.0303
a800	-2.04541	26.51515	hull	-2.52413	26.51515
a800	-2.12796	25	a800	-2.67177	25
hull	-2.36887	23.48485	a800	-2.81984	23.48485
a800	-2.38267	21.9697	hull	-2.89667	21.9697
hull	-2.3907	20.45455	a800	-2.98293	20.45455
hull	-2.53161	18.93939	a800	-3.02371	18.93939
hull	-2.58267	17.42424	a800	-3.08594	17.42424
a800	-2.65331	15.90909	a800	-3.13743	15.90909
hull	-2.72018	14.39394	hull	-3.28594	14.39394
a800	-3.23161	12.87879	hull	-3.62371	12.87879
a800	-3.72997	11.36364	hull	-3.77177	11.36364
a800	-3.74352	9.848485	hull	-3.85761	9.848485
a800	-4.32018	8.333333	a800	-3.9486	8.333333
hull	-4.66899	6.818182	a800	-4.14173	6.818182
a800	-4.7907	5.30303	a800	-4.55761	5.30303
hull	-4.82997	3.787879	hull	-5.01641	3.787879
hull	-5.34352	2.272727	hull	-5.5486	2.272727
a800	-6.72997	0.757576	a800	-5.67177	0.757576