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SUBJECT: Provides response to 981116 & 960228 RAIs re GL 92-01. Revised pressurized thermal shock evaluation based on new weld chemistry info & copy of W rept WCAP-15074, "Evaluation of 1P3571 Weld Metal from Surveillance Programss...," encl.

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INDIANA MICHIGAN POWER

June 28, 1999 C0699-01

Docket No.: 50-315

U.S. Nuclear Regulatory Commission
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Donald C. Cook Nuclear Plant, Unit 1
REQUEST FOR ADDITIONAL INFORMATION
REACTOR PRESSURE VESSEL INTEGRITY
(TAC NO. MA0539)

References: (1) Letter, John F. Stang, Jr. to Robert P. Powers, "REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING REACTOR PRESSURE VESSEL INTEGRITY AT DONALD C. COOK NUCLEAR PLANT, UNIT 1, TAC MA0539", dated November 16, 1998.

(2) Letter, John Hickman to E. E. Fitzpatrick, "REQUEST FOR ADDITIONAL INFORMATION (RAI) ON REACTOR PRESSURE VESSEL INTEGRITY ASSESSMENT FOR D.C. COOK UNIT 1 (TAC NO. M92664)", dated February 28, 1996.

Gentlemen:

In accordance with 10 CFR 50.54(f), Indiana Michigan Power Company (I&M) herein provides the response to the NRC's request for additional information (RAI) regarding Generic Letter 92-01 (References 1 and 2). The responses are contained in the attachments to this letter, and they are based on the new reactor vessel weld chemistry properties information reported in Combustion Engineering Owners Group Report (CE NPSD-1039, Revision 02).

Attachment 1 contains the responses to the RAI noted in reference 1. Attachment 2 is the revised pressurized thermal shock evaluation based on the new weld chemistry information as requested in RAI item number 2. Attachment 3 is a copy of Westinghouse report WCAP-15074, "Evaluation of the 1P3571 Weld Metal from the Surveillance Programs for Kewaunee and Maine Yankee", dated September 1998.

Attachments 1 and 2 also respond to the request for additional information noted in reference 2.

A001

This submittal contains one commitment:

Revised heatup and cooldown operating limit curves and LTOP setpoints will be submitted for unit 1 by December 22, 2000.

Sincerely,

M. W. Rencheck
Vice President Nuclear Engineering

\rgv

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 28th DAY OF June 1999

Jan Watson
NOTARY PUBLIC

My Commission Expires:

JAN WATSON
NOTARY PUBLIC, BERRIEN COUNTY, MI
MY COMMISSION EXPIRES FEB. 10, 2003

Attachments

c: J. E. Dyer, w/attachments
MDEQ - DW & RPD
NRC Resident Inspector, w/attachments
R. Whale

JAN WATSON
NOTARY PUBLIC, BERRIEN COUNTY, MI
MY COMMISSION EXPIRES FEB. 10, 2003

Attachment 1 to C0699-01

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING REACTOR PRESSURE VESSEL STRUCTURAL INTEGRITY AT COOK NUCLEAR PLANT UNIT 1

Background

In May 1995, the NRC issued Generic Letter (GL) 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity." This GL requested that a review of reactor pressure vessel (RPV) structural integrity assessments be performed in order to identify, collect, and report any new data pertinent to the analysis of the structural integrity of the RPV and to assess the impact of those data on RPV integrity analyses for Cook Nuclear Plant Unit 1. An interim response to this generic letter was submitted for Unit 1 on November 20, 1995 [1].

Since then, new information on reactor vessel materials has become available as a result of the Combustion Engineering Owners Group (CEOG) efforts to evaluate reactor vessel weld properties. On November 16, 1998, a request for additional information (RAI) [7] was issued to Indiana Michigan Power Company (I&M) requesting that a reevaluation of the RPV weld chemistry be performed in light of the information presented in the CEOG report [3]. The RAI also requests an evaluation on the use of surveillance data for determining embrittlement in vessel beltline materials. This response addresses the items in the latest NRC RAI and evaluates the effect on pressure-temperature (PT) limits for Cook Nuclear Plant Unit 1.

Request for Additional Information Item 1

"Based on this information, and in accordance with the provisions of Generic Letter 92-01, Revision 1, Supplement 1, the NRC requests the following:

1. An evaluation of the information in the reference above (e.g. CE NPSD-1039, Revision 2) and an assessment of its applicability to the determination of the best-estimate chemistry for all of your RPV beltline welds. Based upon this reevaluation, supply the information necessary to completely fill out the data requested in Table 1 for each RPV beltline weld material. Also, provide a discussion for the copper and nickel values chosen for each weld wire heat noting what heat-specific data were included and excluded from the analysis and the analysis method chosen for determining the best-estimate. If the limiting material for your vessel's PTS/PT limits evaluation is not a weld, include the information requested in Table 1 for the limiting material also. Furthermore, you should consider the information provided in Section 2.0 of the RAI on the use of surveillance data when responding."

   Furthermore, in the determination of best-estimate chemistry, the NRC requests that the response "should also consider what method should be used for grouping sets of chemistry data (in particular, those from weld qualification tests) as being from 'one weld' or from multiple welds. This is an important consideration when a mean-of-the-means or coil-weighted average approach is determined to be the appropriate method for determining the best-estimate chemistry. If a weld (or

welds) were fabricated as weld qualification specimens by the same manufacturer, within a short time span, using similar welding input parameters, and using the same coil (or coils in the case of tandem arc welds) of weld consumables, it may be appropriate to consider all chemistry samples from that weld (or welds) as samples from 'one weld' for the purposes of best-estimate chemistry determination. If information is not available to confirm the aforementioned details, but sufficient evidence exists to reasonably assume the details are the same, the best-estimate chemistry should be evaluated both by assuming the data came from 'one weld' and by assuming that the data came from an appropriate number of 'multiple welds'. A justification should then be provided for which assumption was chosen when the best-estimate chemistry was determined."

Response to Item 1

The Cook Nuclear Plant Unit 1 reactor pressure vessel was fabricated by Combustion Engineering. The submerged arc weld heats in the reactor vessel beltline include heat numbers 13253/12008 and 1P3571. The limiting material for the Cook Nuclear Plant Unit 1 PT limits is currently identified as intermediate plate B4406-3 (heat number C3506) [2], with a projected 1/4t adjusted reference temperature (ART) value of 171°F at 32 effective full power years (EFPY). This reevaluation considers new information for the vessel beltline welds. The revised ART values for these beltline materials are given in Table 1.

The weld material property data were gathered from the CEOG report submitted to the NRC [3] including the recent update performed by ABB-CE in June 1998[4]. ATI Consulting performed an additional review of the validity of the chemistry data to assure the accuracy and completeness of the CEOG evaluation. The search focused on the vessel beltline welds for Cook Nuclear Plant Unit 1.

The tandem weld wire 13253/12008, which is in the lower shell axial weld of the Unit 1 vessel, also exists in Fermi 2, Fitzpatrick, Maine Yankee, and Fort Calhoun vessels. For this tandem weld heat, there are 49 valid chemistry measurements in the CEOG database as shown in Table 4. The revised best-estimate chemistry is 0.21 wt% Cu and .873 wt% Ni based on a simple mean. The corresponding chemistry factor (CF)is 208.7°F as determined from the tables in Regulatory Guide 1.99, Revision 2. The current licensing basis best-estimate chemistry for this weld heat is 0.28 wt% Cu and 0.74 wt% Ni, with a CF of 208.7°F. Note: A CF of 184.7°F was used for the same axial welds in the prior PT limits evaluation of the Unit 1 vessel [2] based on plant-specific weld surveillance data.

Weld wire heat number 1P3571 exists in the circumferential weld of the Unit 1 reactor vessel, which is part of the beltline material for PT limits evaluation. This material exists in welds of the Kewaunee, Maine Yankee, and LaSalle reactor vessels. This

heat also exists in the surveillance capsule at Kewaunee, Maine Yankee, LaSalle 1, and Hatch 1. The data from the CEOG report and the coil-weighted average best-estimate chemistries for weld heat 1P3571 are given in Table 5. The revised best-estimate chemistries are determined to be: coil-weighted average Cu = 0.283 wt% , and simple mean Ni = 0.755 wt%, with a CF value of 212.2°F. By comparison, the current licensing basis best-estimate chemistry for this weld heat is 0.28 wt% Cu and 0.74 wt% Ni, with a CF of 208.7°F. Note: A CF of 184.7°F was used for the circumferential weld in the prior PT limits evaluation of the Unit 1 vessel [2] based on plant-specific weld surveillance data.

A further evaluation of the best estimate chemistry for weld heat number 1P3571 is shown in Table 6. The analysis in Table 6 is similar to the CEOG database results in Table 5 with a few exceptions: 1) one data point from a Linde 80 flux weld (group tag g) was determined to be invalid because it was made with a different flux type; 2) several data points from the Maine Yankee weld material were found to be multiple measurements of the same material and these data were averaged to obtain two independent values; and 3) it includes the chemistry values from the Hatch 1 surveillance weld. The Hatch 1 data were determined to be valid measurements based on fabrication records from ABB-CE. The Hatch 1 data (Table 5, group tag e) were not previously considered for the best-estimate weld chemistry [1]) since the pedigree of the material had not yet been established. With these three modifications, the revised best-estimate chemistries are determined to be: coil-weighted average Cu = 0.287 wt%, and simple mean Ni =0.756 wt%, with a CF value of 214.0°F. These results are consistent with the evaluation of weld heat 1P3571 given in Reference 8 (Table 2-3).

Request for Additional Information Item 2

The CEOG report [2] includes updated chemistry estimates for heats of weld metal in CE fabricated vessels. This report not only provides a suggested best estimate value but also includes the source data used in estimating the chemical composition of the heat of material. This permits the determination of the best estimate chemical composition for the various sources of data including surveillance welds. Since the evaluation of surveillance data rely on both the best estimate chemical composition of the RPV weld and the surveillance weld, the information in these reports may result in the need to revise previous evaluations of RPV integrity (including LTOP setpoints and PT limits) per the requirements of 10 CFR 50.60, and Appendices G and H to 10 CFR Part 50.

"Based on this information and consistent with the provisions of Generic Letter 92-01, Revision 1, Supplement 1, the NRC requests the following:

2. that (1) the information listed in Table 2, Table 3, and the CF from the surveillance data be provided for each heat of material for which surveillance weld data are available and a revision in the RPV integrity analyses (i.e., current

licensing basis) is needed or (2) a certification that previously submitted evaluations remain valid. Separate tables should be used for each heat of material addressed. If the limiting material for vessel's PTS/PT limits evaluation is not a weld, include the information requested in the tables for the limiting material (if surveillance data are available for this material)."

Response to Item 2

The measured surveillance data from the available capsule analyses for weld heat number 1P3571 are provided in Table 2 [8]. Four irradiated capsules are available from Kewaunee, and four irradiated capsules are available from the Maine Yankee surveillance programs. The measured fluence, measured change in the reference temperature (ΔRT_{NDT}, i.e., 30 ft-lb temperature shift), and irradiation temperatures are provided for each of these capsules. The chemistries for the surveillance weld materials are also provided in Table 2. Based on the information in this table, the best-fit CF can be determined and the credibility of the surveillance data can be evaluated. The surveillance data evaluation with adjustments for chemistry and temperature follows the methodology outlined in "Example Case 5 - Surveillance Data not Available from Plant but Available from Other Sources" [6]. First, the data are normalized to the mean copper and nickel chemistry of the surveillance specimens, and then they are adjusted to the mean irradiation temperature using the equation:

$$\text{Adjusted } \Delta RT_{NDT} = \frac{\text{Table CF}_{Mean}}{\text{Table CF}_{Capsule}} * \text{Measured } \Delta RT_{NDT} + (Tirr_{Mean} - Tirr_{Capsule})$$

Table 3 shows the results of the Kewaunee and Maine Yankee surveillance data including adjustments. A best fit to the adjusted surveillance data for weld heat number 1P3571 is determined to be 216.5°F. The predicted ΔRT_{NDT} values are determined for the appropriate fluences for each capsule, and the Adjusted - Predicted ΔRT_{NDT} values are given in Table 3. The scatter in the data falls within the required 28°F (1-sigma) for weld data; therefore, the data is credible and, according to Reference 5, a smaller margin term (σ_Δ = 14°F for welds) can be used. Further adjustments were made to the vessel CF value using the ratio procedure to account for chemistry differences between the capsule materials and the vessel as follows:

$$\text{Ratio Adjusted CF}^{(a)} = 216.5 * \frac{CF_{Table,\ Vessel\ Chem.}}{CF_{Table,Surv,\ Chem}} = 216.5 * \frac{214.0}{211.9} = 218.6°F$$

[a] ratio adjusted CF calculated for weld 1P3571 in D. C. Cook 1 vessel from available surveillance data

These credible surveillance weld results are included in the calculation of ART at the 1/4t location for weld heat number 1P3571 (as shown in Table 1).

Request for Additional Information Item 3

3. "If the limiting material for your plant changes or if the adjusted reference temperature for the limiting material increases as a result of the above evaluations, provide the revised RT_{PTS} value for the limiting material in accordance with 10 CFR 50.61. In addition, if the adjusted RT_{NDT} value increased, provide a schedule for revising the PT and LTOP limits. The schedule should ensure that compliance with 10 CFR 50 Appendix G is maintained."

Response to Item 3

The evaluation provided here shows that with the revised best-estimate chemistry and use of available surveillance data for the Cook Nuclear Plant Unit 1 vessel beltline welds, the limiting material for PT limits becomes circumferential weld heat 1P3571, not beltline plate heat C3506. This change corresponds to an increase of 25.3°F in the calculated 1/4t ART value for limiting beltline material at 32 EFPY. Revised heatup and cooldown operating limit curves and LTOP setpoints will be submitted for Unit 1 by December 22, 2000. The current heatup/cooldown curves in the Unit 1 Technical Specifications are valid for approximately 3.92 EFPY from the day Unit 1 is restarted.

Attachment 2 shows the effect of revised RT_{PTS} for the Unit 1 vessel. The effect of including the new weld data is an 11.2°F decrease in the RT_{PTS} value for the limiting weld heat 1P3571 (from 238.6°F to 227.4°F). The revised RT_{PTS} value of 227.4°F is well below the PTS screening criteria limit of 300°F for circumferential welds. The prior PTS assessment for the Unit 1 vessel [9] remains valid, and this new evaluation shows that the previous analysis is conservative. Thus, there is no impact of this additional weld data on the projected RT_{PTS} for the Unit 1 vessel at end-of-life fluence (32 EFPY).

The following tables are included as a part of this attachment:

Table 1: Information Requested on RPV Weld and/or Materials for P-T Limits Evaluations.

Table 2: Surveillance Data for Weld Heat No. 1P3571.

Table 3: Adjustments to Surveillance Data for Weld Heat No. 1P3571.

Table 4: CEOG Chemistry Data for Weld Wire Heat No. 13253/12008.

Table 5: CEOG Chemistry Data for Weld Wire Heat No. 1P3571.

Table 6: Evaluation of Chemistry for Weld Wire Heat No. 1P3571.

References

1. Letter AEP:NRC:1173F, "Donald C. Cook Nuclear Plant Units 1 and 2, Response to NRC Generic Letter 92-01, Revision 1, Supplement 1, Reactor Vessel Structural Integrity," dated November 20, 1995.

2. "Analysis of Capsule U from the American Electric Power Company D. C. Cook Unit 1 Reactor Vessel Radiation Surveillance Program," WCAP-12483, January 1990.

3. "Best Estimate Copper and Nickel Values in CE Fabricated Reactor Vessel Welds," CE NPSD-1039, Revision 2, Final Report, Prepared for CE Owners Group, June 1997.

4. "Updated Analysis for Combustion Engineering Fabricated Reactor Vessel Welds, Best Estimate Copper and Nickel Content," CE NPSD-1119, Revision 1, Prepared for CE Owners Group, July 1998.

5. 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," Federal Register, Volume 60, Number 243, December 19, 1995.

6. Memorandum from Keith R. Wichman to Edmund J. Sullivan, "Meeting Summary for November 12, 1997 Meeting with Owners Group Representatives and NEI Regarding Review of Responses to Generic Letter 92-01, Revision 1, Supplement 1 Responses," dated November 19, 1997.

7. "Request for Additional Information Regarding Reactor Pressure Vessel Integrity at Donald C. Cook Nuclear Plant, Unit 1, TAC No. MA0539," dated November 16, 1998.

8. "Evaluation of the 1P3571 Weld Metal from the Surveillance Programs for Kewaunee and Maine Yankee," WCAP-15074, dated September 1998.

9. Letter AEP:NRC:0561D, "Donald C. Cook Nuclear Plant Units 1 and 2, Updated Reference Temperature, Pressurized Thermal Shock Analyses," dated August 7, 1990.

Table 1. Information Requested on RPV Weld and/or Materials for P-T Limits Evaluation

Facility: D. C. Cook 1
Vessel Manufacturer: Combustion Engineering
Plate and Weld Thickness (w/o cladding): 8.5 inches
32 EFPY Peak (ID) Fluence: 1.41×10^{19} n/cm^2
32 EFPY Peak (1/4t) Fluence: 8.46×10^{18} n/cm^2
32 EFPY Axial Weld (ID) Fluence: 9.5×10^{18} n/cm^2
32 EFPY Axial Weld (1/4t) Fluence: 5.7×10^{18} n/cm^2

RPV Weld Wire or Plate Heat Number[1]	Best-Estimate Copper (wt%)	Best-Estimate Nickel (wt%)	1/4t Fluence (x 10^{19}) (n/cm^2)	Assigned Material Chemistry Factor (CF) (°F)	Method of Determining CF[2] (°F)	Initial RT_{NDT} ($RT_{NDT(U)}$) (°F)	σ_I (°F)	σ_Δ (°F)	Margin (°F)	1/4t ART at 32 EFPY (°F)
13253/12008 (weld)	0.21	0.873	0.57	208.7	Tables	-56	17	28	66	185.9
1P3571 (weld)	0.287	0.756	0.846	218.6[3]	Surv. Data	-56	17	14	44	196.3
C3506 (plate)	0.15	0.49	0.846	119.6	Surv. Data	40	0	17	17	171.0

(1) weld heat number or the material identification of the limiting material
(2) determined from tables or from surveillance data
(3) ratio adjusted CF value to account for chemistry differences between the capsule materials and the vessel

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat

Weld Wire Heat	Discussion
13253/12008	Simple mean Cu and Ni (see Table 4)
1P3571	Coil-weighted Cu, simple mean Ni (see Table 6)

Table 2: Surveillance Data for Weld Heat No. 1P3571

Plant	Capsule ID (including source)	Cu (wt%)	Ni (wt%)	Irradiation Temperature (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
Kewaunee	V	0.219	0.724	532	.597 [a]	175 [a]	Y
Kewaunee	R	0.219	0.724	532	1.81 [a]	235 [a]	Y
Kewaunee	P	0.219	0.724	532	2.74 [a]	230 [a]	Y
Kewaunee	S	0.219	0.724	532	3.36 [a]	250 [a]	Y
Maine Yankee	W263	0.351	0.771	533	.567 [a]	222 [a]	Y
Maine Yankee	W253	0.351	0.771	542	1.25 [a]	260 [a]	Y
Maine Yankee	A25	0.351	0.771	522	1.76 [a]	270 [a]	Y
Maine Yankee	A35	0.351	0.771	533	7.13 [a]	345 [a]	Y
	Mean:	0.285	0.748	532.3			

Table $CF_{Kewaunee}$ = 187.2 °F, Table $CF_{Maine\ Yankee}$ = 237.3 °F, Table CF_{mean} = 211.9 °F

[a] from Ref. 8, "Evaluation of the 1P3571 Weld Metal from the Surveillance Programs for Kewaunee and Maine Yankee," WCAP-15074, September 1998.

Table 3: Adjustments to Surveillance Data for Weld Heat No. 1P3571

Plant	Capsule ID (including source)	Cu (wt%)	Ni (wt%)	Irradiation Temperature (°F)	Fluence Factor [a]	Measured ΔRT_{NDT} (°F)	Adjusted ΔRT_{NDT} [b] (°F)	Predicted ΔRT_{NDT} [c] (°F)	(Adjusted - Predicted) ΔRT_{NDT} (°F)
Kewaunee	V	0.219	0.724	532	0.856	175	198.4	185.2	13.2
Kewaunee	R	0.219	0.724	532	1.163	235	266.3	251.7	14.6
Kewaunee	P	0.219	0.724	532	1.269	230	260.7	274.7	-14.0
Kewaunee	S	0.219	0.724	532	1.317	250	283.3	285.1	-1.9
Maine Yankee	W263	0.351	0.771	533	0.841	222	197.5	182.1	15.4
Maine Yankee	W253	0.351	0.771	542	1.062	260	222.5	229.9	-7.5
Maine Yankee	A25	0.351	0.771	522	1.155	270	251.4	250.1	1.3
Maine Yankee	A35	0.351	0.771	533	1.466	345	307.4	317.3	-9.9

[a] Fluence Factor (FF) = $fluence^{(0.28 - 0.10 \log(fluence))}$ for fluence values shown in Table 2

[b] Adjusted $\Delta RT_{NDT} = \left(\frac{\text{Table } CF_{Mean}}{\text{Table } CF_{Capsule}} \right) * \text{Measured } \Delta RT_{NDT} + (Tirr_{Mean} - Tirr_{Capsule})$

[c] Predicted $\Delta RT_{NDT} = FF * CF$

where $CF = \Sigma (FF * \Delta RT_{NDT}) \div \Sigma (FF^2) = 2326.78 \div 10.749 = 216.5$ °F

Table 4. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Summary of Properties for Weld Wire Heat No. 13253/12008

Source: CEOG CE NPSD-1039 Revision 2

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.22	.76	C.E.	CEOG Database	WDC-0155	b
13253/12008	Linde 1092	3791	.22	.76	C.E.	CEOG Database	WDC-0156	b
13253/12008	Linde 1092	3791	.22	.77	C.E.	CEOG Database	WDC-0158	b
13253/12008	Linde 1092	3791	.22	.77	C.E.	CEOG Database	WDC-0159	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0160	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0161	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0162	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0163	b
13253/12008	Linde 1092	3791	.20	.86	C.E.	CEOG Database	WDC-0165	b
13253/12008	Linde 1092	3791	.20	.86	C.E.	CEOG Database	WDC-0166	b
13253/12008	Linde 1092	3791	.20	.87	C.E.	CEOG Database	WDC-0167	b

Table 4. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.20	.87	C.E.	CEOG Database	WDC-0168	b
13253/12008	Linde 1092	3791	.22	.87	C.E.	CEOG Database	WDC-0169	b
13253/12008	Linde 1092	3791	.20	.88	C.E.	CEOG Database	WDC-0170	b
13253/12008	Linde 1092	3791	.21	.88	C.E.	CEOG Database	WDC-0171	b
13253/12008	Linde 1092	3791	.21	.88	C.E.	CEOG Database	WDC-0172	b
13253/12008	Linde 1092	3791	.21	.88	C.E.	CEOG Database	WDC-0173	b
13253/12008	Linde 1092	3791	.22	.88	C.E.	CEOG Database	WDC-0174	b
13253/12008	Linde 1092	3791	.22	.88	C.E.	CEOG Database	WDC-0175	b
13253/12008	Linde 1092	3791	.22	.88	C.E.	CEOG Database	WDC-0176	b
13253/12008	Linde 1092	3791	.20	.89	C.E.	CEOG Database	WDC-0177	b
13253/12008	Linde 1092	3791	.20	.89	C.E.	CEOG Database	WDC-0178	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0179	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0180	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0181	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0182	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0183	b

Table 4. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0184	b
13253/12008	Linde 1092	3791	.22	.89	C.E.	CEOG Database	WDC-0185	b
13253/12008	Linde 1092	3791	.22	.89	C.E.	CEOG Database	WDC-0186	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0187	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0188	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0189	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0190	b
13253/12008	Linde 1092	3791	.21	.90	C.E.	CEOG Database	WDC-0191	b
13253/12008	Linde 1092	3791	.21	.90	C.E.	CEOG Database	WDC-0192	b
13253/12008	Linde 1092	3791	.21	.90	C.E.	CEOG Database	WDC-0193	b
13253/12008	Linde 1092	3791	.22	.90	C.E.	CEOG Database	WDC-0194	b
13253/12008	Linde 1092	3791	.22	.90	C.E.	CEOG Database	WDC-0195	b
13253/12008	Linde 1092	3791	.20	.91	C.E	CEOG Database	WDC-0196	b
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0197	b
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0198	b

Table 4. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0199	b
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0200	b
13253/12008	Linde 1092	3791	.21	.91	C.E.	CEOG Database	WDC-0201	b
13253/12008	Linde 1092	3791	.20	.92	C.E.	CEOG Database	WDC-0202	b
13253/12008	Linde 1092	3791	.20	.92	C.E.	CEOG Database	WDC-0203	b
13253/12008	Linde 1092	3791	.21	.92	C.E.	CEOG Database	WDC-0204	b
13253/12008	Linde 1092	3791; 3833	.24	.875	C.E.	CEOG Database	WDC-0205	b

Best Estimate Cu = 0.21 wt% **Best Estimate Ni = 0.873 wt%** **Basis: Simple mean Cu and Ni**

Note: Using best-estimate chemistry, CF = 208.7 °F from Reg. Guide 1.99, Rev. 2 Tables

Table 5. CEOG Chemistry Data for Weld Wire Heat No. 1P3571

Summary of Properties for Weld Wire Heat No. 1P3571

Source: CEOG CE NPSD-1039 Revision 2

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.17	.51	KWE, Supp. "V"	WPS, 8/21/95	WDC-0426	b
1P3571	Linde 1092	3958	.15	.54	KWE, Supp. "P"	WPS, 8/21/95	WDC-0427	b
1P3571	Linde 1092	3958	.17	.61	KWE, Supp. "V"	WPS, 8/21/95	WDC-0428	b
1P3571	Linde 1092	3958	.17	.64	KWE, Supp. "R"	WPS, 8/21/95	WDC-0429	b
1P3571	Linde 1092	3958	.18	.67	KWE, Supp. "R"	WPS, 8/21/95	WDC-0430	b
1P3571	Linde 1092	3958	.19	.67	KWE, Supp. "V"	WPS, 8/21/95	WDC-0431	b
1P3571	Linde 1092	3958	.19	.67	KWE, Supp. "P"	WPS, 8/21/95	WDC-0432	b
1P3571	Linde 1092	3958	.186	.689	KWE, Supp. "S"	WPS, 8/21/95	WDC-0433	b
1P3571	Linde 1092	3958	.20	.70	KWE, Supp. "V"	WPS, 8/21/95	WDC-0434	b
1P3571	Linde 1092	3958	.19	.71	KWE, Supp. V"	WPS, 8/21/95	WDC-0435	b
1P3571	Linde 1092	3958	.172	.717	KWE, SC "P"	WCAP-13257	WDC-0436	b
1P3571	Linde 1092	3958	.34	.72	KWE, Supp. "R"	WCAP-13257	WDC-0437	b
1P3571	Linde 1092	3958	.22	.73	KWE, Surv. Test	WPS, 8/21/95	WDC-0438	b

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 5. CEOG Chemistry Data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.191	.734	KWE, SC "P"	WCAP-13257	WDC-0439	b
1P3571	Linde 1092	3958	.066	.736	KWE, SC "R"	WCAP-13257	WDC-0440	b
1P3571	Linde 1092	3958	.24	.74	KWE, Surv. Test	WPS, 8/21/95	WDC-0441	b
1P3571	Linde 1092	3958	.182	.742	KWE, SC "P"	WCAP-13257	WDC-0442	b
1P3571	Linde 1092	3958	.354	.742	KWE, SC "P"	WCAP-13257	WDC-0443	b
1P3571	Linde 1092	3958	.207	.769	KWE, SC "R"	WCAP-13257	WDC-0444	b
1P3571	Linde 1092	3958	.20	.77	KWE, SC Unirr.	WCAP-8107	WDC-0445	b
1P3571	Linde 1092	3958	.43	.78	KWE, Surv. Test	WPS, 8/21/95	WDC-0446	b
1P3571	Linde 1092	3958	.23	.79	KWE, Surv. Test	WPS, 8/21/95	WDC-0447	b
1P3571	Linde 1092	3958	.209	.795	KWE, Supp. "S"	WPS, 8/21/95	WDC-0448	b
1P3571	Linde 1092	3958	.22	.80	KWE, Surv. Test	WPS, 8/21/95	WDC-0449	b
1P3571	Linde 1092	3958	.434	.80	KWE, SC "V"	WCAP-13257	WDC-0450	b
1P3571	Linde 1092	3958	.196	.803	KWE, Supp. "S"	WPS, 8/21/95	WDC-0451	b
1P3571	Linde 1092	3958	.214	.816	KWE, SC "V"	WCAP-13257	WDC-0452	b

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 5. CEOG Chemistry Data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.223	.871	KWE, Supp. "S"	WCAP-13257	WDC-0453	b
1P3571	Linde 1092	3958	.25	.66	MY, SC 263 deg.	BCL-585-21	WDC-0454	c
1P3571	Linde 1092	3958	.25	.70	MY, SC 263 deg.	BCL-585-21	WDC-0455	c
1P3571	Linde 1092	3958	.33	.70	MY, SC 263 deg.	BCL-585-21	WDC-0456	c
1P3571	Linde 1092	3958	.33	.71	MY, SC 263 deg.	BCL-585-21	WDC-0457	c
1P3571	Linde 1092	3958	.356	.728	MY, SC 253 deg.	WCAP-12819	WDC-0458	c
1P3571	Linde 1092	3958	.432	.745	MY, SC 253 deg.	WCAP-12819	WDC-0460	c
1P3571	Linde 1092	3958	.365	.78	MY, SC Unirr.	CR-75-269	WDC-0463	c
1P3571	Linde 1092	3958	.34	.73	MY, Supp. C04-01	WPS, 8/21/95	WDC-0468	c
1P3571	Linde 1092	3958	.30	.76	MY, Supp. C04-11	WPS, 8/21/95	WDC-0469	c
1P3571	Linde 1092	3958	.35	.76	MY, Supp. C04-02	WPS, 8/21/95	WDC-0470	c
1P3571	Linde 1092	3958	.33	.77	MY, Supp. C04-05	WPS, 8/21/95	WDC-0471	c
1P3571	Linde 1092	3958	.31	.78	MY, Supp. C04-07	WPS, 8/21/95	WDC-0472	c
1P3571	Linde 1092	3958	.32	.78	MY, Supp. C04-08	WPS, 8/21/95	WDC-0473	c

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 5. CEOG Chemistry Data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.32	.78	MY, Supp. C04-09	WPS, 8/21/95	WDC-0474	c
1P3571	Linde 1092	3958	.32	.78	MY, Supp. C04-10	WPS, 8/21/95	WDC-0475	c
1P3571	Linde 1092	3958	.33	.78	MY, Supp. C04-04	WPS, 8/21/95	WDC-0476	c
1P3571	Linde 1092	3958	.37	.80	MY, Supp. C04-01	WPS, 8/21/95	WDC-0477	c
1P3571	Linde 1092	3958	.38	.80	MY, Supp. C04-13	WPS, 8/21/95	WDC-0478	c
1P3571	Linde 1092	3958	.52	.80	MY, Supp. C04-15	WPS, 8/21/95	WDC-0479	c
1P3571	Linde 1092	3958	.53	.81	MY, Supp. C04-09	WPS, 8/21/95	WDC-0480	c
1P3571	Linde 1092	3958	.21	.88	C.E.	CEOG Database	WDC-0481	c
1P3571	Linde 1092	3958	.20	.73	LS1, SC 44U	GE-NE-A166-1294-R1	WDC-0483	d
1P3571	Linde 1092	3958	.22	.73	LS1, SC 44M	GE-NE-A166-1294-R1	WDC-0484	d
1P3571	Linde 1092	3958	.20	.74	LS1, SC 44LD	GE-NE-A166-1294-R1	WDC-0485	d
1P3571	Linde 1092	3958	.20	.75	LS1, SC 443	GE-NE-A166-1294-R1	WDC-0486	d
1P3571	Linde 1092	3958	.22	.75	LS1, SC 444	GE-NE-A166-1294-R1	WDC-0487	d
1P3571	Linde 1092	3958	.20	.76	LS1, SC 44A	GE-NE-A166-1294-R1	WDC-0488	d

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 5. CEOG Chemistry Data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.22	.79	LS1, SC 447	GE-NE-A166-1294-R1	WDC-0490	d
1P3571	Linde 1092	3958	.21	.80	LS1, SC 45K	GE-NE-A166-1294-R1	WDC-0491	d
1P3571	Linde 1092	3958	.21	.80	LS1, SC 45M	GE-NE-A166-1294-R1	WDC-0492	d
1P3571	Linde 1092	3958	.22	.80	LS1, SC 45D	GE-NE-A166-1294-R1	WDC-0493	d
1P3571	Linde 1092	3958	.23	.82	LS1, SC 45E	GE-NE-A166-1294-R1	WDC-0494	d
1P3571	Linde 1092	3958	.22	.83	LS1, SC 44F	GE-NE-A166-1294-R1	WDC-0495	d
1P3571	Linde 1092	3958	.21	.78	LS1, SC Unirr.	WPS, 8/21/95	WDC-0496	d
1P3571	Linde 1092	3958		.76	HA1, SC	NEDC-30997	WDC-0497	e
1P3571	Linde 1092	3958	.28	.76	HA1, SC	NEDC-30997	WDC-0498	e
1P3571	Linde 1092	3958	.28	.76	HA1, SC	NEDC-30997	WDC-0499	e
1P3571	Linde 1092	3958	0.32	0.82	HA1, SC	NE-B1100691-01	WDC-1879	e
1P3571	Linde 1092	3958	0.32	0.87	HA1, SC	NE-B1100691-01	WDC-1880	e
1P3571	Linde 1092	3958	0.32	0.87	HA1, SC	NE-B1100691-01	WDC-1881	e

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 5. CEOG Chemistry Data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.37	.75	C.E., WQ M1.43	CEOG Database	WDC-0500	f
1P3571	Linde 1092	3958	.40	.82	C.E., WQ M1.42	CEOG Database	WDC-0425	a
1P3571	Linde 80	0344	.22	.67	Wire/Flux Qual.	CEOG Database	WDC-0482	g

Best Estimate Cu = 0.283 wt% **Best Estimate Ni = 0.755 wt%** **Basis: Coil weighted Cu, weighted Ni**

Note: Using best-estimate chemistry, CF = 212.2 °F from Reg. Guide 1.99, Rev. 2 Tables

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 6. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE I.D.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		Kewaunee, Single Arc				0.219	0.724	4
0.17	0.51	INDETERMINATE Ni	WDC-0426		b			
0.15	0.54	INDETERMINATE Ni	WDC-0427	MSE-MNA-229(95)	b			
0.17	0.61	VALID	WDC-0428		b			
0.17	0.64	VALID	WDC-0429		b			
0.18	0.67	VALID	WDC-0430		b			
0.19	0.67	VALID	WDC-0431		b			
0.19	0.67	VALID	WDC-0432	MSE-MNA-229(95)	b			
0.186	0.689	VALID	WDC-0433	MSE-MNA-229(95)	b			
0.20	0.70	VALID	WDC-0434		b			
0.19	0.71	VALID	WDC-0435	MSE-MNA-229(95)	b			
0.172	0.717	VALID	WDC-0436		b			
0.34	0.72	VALID	WDC-0437		b			
0.22	0.73	VALID	WDC-0438		b			
0.191	0.734	VALID	WDC-0439	WCAP-14280	b			
0.066	0.736	INDETERMINATE Cu?	WDC-0440		b			
0.24	0.74	VALID	WDC-0441		b			
0.182	0.742	VALID	WDC-0442		b			
0.354	0.742	VALID	WDC-0443		b			
0.207	0.769	VALID	WDC-0444		b			
0.2	0.77	VALID	WDC-0445		b			
0.43	0.78	VALID	WDC-0446		b			
0.23	0.79	VALID	WDC-0447		b			
0.209	0.795	VALID	WDC-0448	MSE-MNA-229(95)	b			
0.22	0.80	VALID	WDC-0449		b			
0.434	0.80	VALID	WDC-0450		b			
0.196	0.803	VALID	WDC-0451	MSE-MNA-229(95)	b			
0.21	0.816	VALID	WDC-0452		b			
0.223	0.871	VALID	WDC-0453	MSE-MNA-229(95)	b			

Table 6. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE I.D.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		Maine Yankee, Single Arc				0.351	0.771	4
0.25*	0.66*	INDETERMINATE	WDC-0454	BCL-585-21	c			
0.25*	0.70*	VALID	WDC-0455	BCL-585-21	c			
0.33**	0.70**	VALID	WDC-0456	BCL-585-21	c			
0.33**	0.71**	VALID	WDC-0457	BCL-585-21	c			
0.356	0.728	VALID	WDC-0458	WCAP-12819	c			
0.432	0.745	VALID	WDC-0460	WCAP-12819	c			
0.365	0.78	VALID	WDC-0463	D9693	c			
0.34	0.73	VALID	WDC-0468	D44441	c			
0.3	0.76	VALID	WDC-0469	D44449	c			
0.35	0.76	VALID	WDC-0470	D44440	c			
0.33	0.77	VALID	WDC-0471	D44443	c			
0.31	0.78	VALID	WDC-0472	D44445	c			
0.32	0.78	VALID	WDC-0473	D44446	c			
0.32	0.78	VALID	WDC-0474	D44447	c			
0.32	0.78	VALID	WDC-0475	D44448	c			
0.33	0.78	VALID	WDC-0476	D44442	c			
0.37	0.80	VALID	WDC-0477	D44439	c			
0.38	0.80	VALID	WDC-0478	D44451	c			
0.52	0.80	VALID	WDC-0479	D44453	c			
0.53	0.81	VALID	WDC-0480	D44452	c			
0.21***	0.88	VALID	WDC-0481	D44454	c			

* two measurements averaged to obtain single value for "best-estimate" evaluation

** two measurements averaged to obtain single value for "best-estimate" evaluation

*** measurement taken at interface with manual stick weld material

Table 6. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE I.D.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		LaSalle-1, Tandem Arc				0.212	0.775	4
0.20	0.73	VALID	WDC-0483		d			
0.22	0.73	VALID	WDC-0484		d			
0.20	0.74	VALID	WDC-0485		d			
0.20	0.75	VALID	WDC-0486		d			
0.22	0.75	VALID	WDC-0487		d			
0.20	0.76	VALID	WDC-0488		d			
0.22	0.79	VALID	WDC-0490		d			
0.21	0.80	VALID	WDC-0491		d			
0.21	0.80	VALID	WDC-0492		d			
0.22	0.80	VALID	WDC-0493		d			
0.23	0.82	VALID	WDC-0494		d			
0.22	0.83	VALID	WDC-0495		d			
0.21	0.78	VALID	WDC-0496	D11341	d			
		Hatch-1, Tandem Arc				0.304	0.807	2
	0.76	VALID	WDC-0497	NEDC-30997	e			
0.28	0.76	VALID	WDC-0498	NEDC-30997	e			
0.28	0.76	VALID	WDC-0499	NEDC-30997	e			
0.32	0.82	INDETERMINATE	WDC-1879	NE-B1100691-01	e			
0.32	0.87	INDETERMINATE	WDC-1880	NE-B1100691-01	e			
0.32	0.87	INDETERMINATE	WDC-1881	NE-B1100691-01	e			

Table 6. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE I.D.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		Weld Qualification, Tandem Arc				0.370	0.750	2
0.37	0.75	VALID	WDC-0500	D8698	f			
		Weld Qualification, Single Arc				0.400	0.820	1
0.40	0.82	VALID	WDC-0425	D8669	a			
		Weld Qualification, Linde 80 Flux Type				0.220	0.670	1
0.22	0.67	INVALID	WDC-0482	D19780	g	Note: Group Tag g data not used in analysis		

Coil Weighted Avg.
Cu
0.287 wt%

Simple Mean
Ni
0.756 wt%

Note: Using best-estimate chemistry, CF = 214.0 °F from Reg. Guide 1.99, Rev. 2 Tables

Attachment 2 to C0699-01

FINAL RESPONSE TO NRC GENERIC LETTER 92-01, REVISION 1, SUPPLEMENT 1 FOR PRESSURIZED THERMAL SHOCK

Background

The Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity" on May 19, 1995. This supplement required that addressees identify, collect, and report any new data pertinent to analysis of the structural integrity of their reactor pressure vessels (RPVs) and assess the impact of this new data on their RPV integrity analysis. An interim response to this GL was submitted for Cook Nuclear Plant Unit 1 on November 20, 1995 [1]. Since then, the NRC reviewed this response and requested that Indiana Michigan Power Company (I&M) perform additional analyses to consider any new information on the vessel beltline welds, including the data from the Combustion Engineering Owners Group (CEOG) database, and, if necessary, to update the prior PTS evaluation for Unit 1 [2] using the coil-weighted method for best-estimate copper chemistry of weld heat 1P3571. This attachment documents the data for weld heats 1P3571, 13253, and 13253/12008, computes best-estimate chemistries for these welds in light of the new CEOG data, evaluates surveillance weld data for weld heat number 1P3571, and provides a revised pressurized thermal shock (PTS) assessment of the Unit 1 reactor pressure vessel.

Reevaluation of Unit 1 Vessel Welds for PTS

The reactor vessel for Unit 1 was fabricated by Combustion Engineering. The weld material property data were gathered from the comprehensive CEOG database [3] including the recent update performed by ABB-CE [4]. ATI Consulting performed an additional review of the validity of the chemistry data to assure the accuracy and completeness of the CEOG evaluation. The database search focused on the vessel beltline and surveillance capsule welds for Unit 1. The welds of interest are heats 1P3571, 13253/12008, and 13253.

Weld wire heat number 1P3571 exists in the circumferential weld of the Unit 1 reactor vessel, which is part of the beltline material for PTS evaluation. This material also exists in welds of Kewaunee, Maine Yankee, and LaSalle reactor vessels. This heat also exists in the surveillance capsules at Kewaunee, Maine Yankee, LaSalle 1 and Hatch 1.

The valid chemistry data for 1P3571 from the CEOG report [3] are shown in Table 1. The assessment of all relevant data for heat 1P3571 shows the coil-weighted average of the 71 chemistry measurements to be 0.283 wt% Cu, and a simple mean value of 0.755 wt% Ni. The corresponding chemistry factor (CF) is 212.2°F as determined from the tables in Regulatory Guide 1.99, Revision 2.

An additional evaluation of weld heat number 1P3571 is shown in Table 2. The data are identical to the CEOG database results (shown in Table 1) with a few exceptions: 1) one data point from a Linde 80 flux weld was determined to be invalid because it was made with a different flux type; 2) several data points from the

Maine Yankee weld material were found to be multiple measurements of the same material and these data were averaged to obtain two independent values; and 3) the chemistry values from the Hatch 1 surveillance weld were included. The Hatch 1 data were determined to be valid measurements based on fabrication records from ABB-CE. The Hatch 1 data were not previously considered for the best-estimate weld chemistry evaluation [1] since the pedigree of the material had not yet been established. The coil-weighted averaging method for weld heat 1P3571 given in Table 2 is similar to the method in the CEOG database report [3], but includes the three modifications as noted above for 70 valid measurements. From this revised evaluation, best-estimate chemistries for this weld heat are determined to be: coil-weighted average Cu = 0.287 wt%, and simple mean Ni = 0.756 wt%, with a CF value of 214.0°F. By comparison, the current licensing basis best-estimate chemistry for this weld heat is 0.28 wt% Cu and 0.74 wt% Ni, with a CF of 208.7°F.

The tandem weld wire 13253/12008, which is in the lower shell axial weld of the Unit 1 vessel, also exists in Fermi 2, Fitzpatrick, Maine Yankee, and Fort Calhoun vessels. For this tandem weld heat, there are 49 valid chemistry measurements in the CEOG database as shown in Table 3. The best-estimate chemistry is 0.21 wt% Cu and 0.873 wt% Ni based on a simple mean. The corresponding CF is 208.7°F as determined from the tables in Regulatory Guide 1.99, Revision 2. The current licensing basis best-estimate chemistry for this weld heat is 0.28 wt% Cu and 0.74 wt% Ni, with a CF of 208.7°F. This is identical to the calculated CF for the axial welds in the prior PTS evaluation of the unit 1 vessel. [2]

Weld heat 13253 exists in the Unit 1 surveillance weld specimens and not in the vessel welds. Table 4 shows the eight available measured chemistry data points for weld heat 13253 from the CEOG database. These data do not have an effect on the welds in the Unit 1 vessel for PTS evaluations.

Evaluation and Use of Surveillance Data

According to the NRC Request for Additional Information [5], all surveillance program results for the heats of material in the unit 1 vessel should be considered in evaluating its integrity regardless of source per 10 CFR 50.61. This includes the surveillance data for weld heat number 1P3571 which is contained in both the Kewaunee and Maine Yankee surveillance programs. When assessing credibility of surveillance data that come from more than one source, adjustments to the surveillance data may be needed to account for differences in the chemical composition and irradiation environment of the different sources consistent with the requirements in 10 CFR 50.61. A method for accounting for these differences is discussed in Reference 6.

The measured surveillance data from the available capsule analyses for weld heat number 1P3571 are provided in Table 5. Four irradiated capsules are available from Kewaunee, and four

irradiated capsules are available from the Maine Yankee surveillance programs. The measured fluence, measured ΔRT_{NDT} (i.e., 30 ft-lb temperature shift), and irradiation temperatures are provided for each of these capsules. The chemistries for the surveillance weld materials are also provided in Table 5. Based on the information in this table, the best-fit CF can be determined and the credibility of the surveillance data can be evaluated. The surveillance data evaluation with adjustments for chemistry and temperature follows the methodology outlined in "Example Case 5 - Surveillance Data not Available from Plant but Available from Other Sources" [6]. First, the data are normalized to the mean copper and nickel chemistry of the surveillance specimens, and then they are adjusted to the mean irradiation temperature using the equation:

$$\text{Adjusted } \Delta RT_{NDT} = \frac{\text{Table } CF_{Mean}}{\text{Table } CF_{Capsule}} * \text{Measured } \Delta RT_{NDT} + (Tirr_{Mean} - Tirr_{Capsule})$$

Table 6 shows the results of the Kewaunee and Maine Yankee surveillance data including adjustments. A best fit to the adjusted surveillance data for weld heat number 1P3571 is determined to be 216.5°F. The predicted ΔRT_{NDT} values are determined for the appropriate fluences for each capsule, and the Adjusted - Predicted ΔRT_{NDT} values are given in Table 6. The scatter in the data falls within the required 28°F (1-sigma) for weld data; therefore, the data is credible and, according to Reference 8, a smaller margin term (σ_Δ = 14°F for welds) can be used. Further adjustments were made to the vessel CF value using the ratio procedure to account for chemistry differences between the capsule materials and the vessel as follows:

$$\text{Ratio Adjusted } CF^{(a)} = 216.5 * \frac{CF_{Table,\ Vessel\ Chem.}}{CF_{Table,Surv,\ Chem}} = 216.5 * \frac{214.0}{211.9} = 218.6°F$$

[(a)] ratio adjusted CF calculated for weld 1P3571 in the unit 1 vessel from available surveillance data

These credible surveillance weld results are included in the calculation of RT_{PTS} for weld heat number 1P3571 in the Unit 1 vessel beltline. (Note: no surveillance data exists for weld heat number 13253/12008). Table 7 provides calculations of the updated RT_{PTS} values for these beltline welds at the vessel inside surface. Table 8 shows a comparison of the updated values for RT_{PTS} with the results of the prior PTS analysis for Unit 1 [2].

Summary

A reevaluation of the Unit 1 vessel beltline weld chemistry produced a slight change in the calculated best-estimate chemistries and CF value (from 208.7°F to 214.0°F) for weld heat number 1P3571. The available surveillance data for this weld heat were evaluated (including appropriate adjustments), a best-estimate CF of 216.5°F was calculated, and the scatter in the best fit to the data is determined to be within the required 28°F range for credible surveillance data. The surveillance data

results for weld heat 1P3571 were used (with ratio adjustment) to determine a ratio adjusted CF value of 218.6°F, and a revised RT_{PTS} value for the limiting vessel beltline weld was calculated to be 227.4°F. The effect of this updated CF is an 11.2°F decrease in the RT_{PTS} value for the limiting weld heat 1P3571 (from 238.6°F to 227.4°F). This revised RT_{PTS} value is well below the PTS screening criteria limit of 300°F for circumferential welds. The projected RT_{PTS} values for the other vessel welds and plates are unchanged from the previously submitted PTS evaluation [2]. The prior PTS assessment for the Unit 1 vessel [2] remains valid and is shown to be conservative. Thus, there is no impact of this additional weld data on the projected RT_{PTS} values for the Unit 1 vessel at end-of-life fluence, 32 effective full power years.

The following tables are included as a part of this attachment:

Table 1: CEOG Chemistry data for Weld Wire Heat No. 1P3571.

Table 2: Evaluation of Chemistry for Weld Wire Heat No. 1P3571.

Table 3: CEOG Chemistry Data for Weld Wire Heat No. 13253/12008.

Table 4: CEOG Chemistry Data for Weld Wire Heat No. 13253.

Table 5: Surveillance Data for Weld Heat No. 1P3571.

Table 6: Adjustments to Surveillance Data for Weld Heat No. 1P3571.

Table 7: Information Requested on RPV Weld Materials for PTS Evaluation.

Table 8: RT_{PTS} Values for D. C. Cook 1 Vessel Beltline Materials.

References

1. Letter AEP:NRC:1173F, "Donald C. Cook Nuclear Plant Units 1 and 2, Response to NRC Generic Letter 92-01, Revision 1, Supplement 1, Reactor Vessel Structural Integrity," dated November 20, 1995.

2. Letter AEP:NRC:0561D, "Donald C. Cook Nuclear Plant Units 1 and 2, Updated Reference Temperature, Pressurized Thermal Shock Analyses," dated August 7, 1990.

3. "Best Estimate Copper and Nickel Values in CE Fabricated Reactor Vessel Welds," CE NPSD-1039, Revision 2, Final Report, Prepared for CE Owners Group, dated June 1997.

4. "Updated Analysis for Combustion Engineering Fabricated Reactor Vessel Welds, Best Estimate Copper and Nickel Content," CE NPSD-1119, Revision 1, Prepared for CE Owners Group, July 1998.

5. "Request for Additional Information Regarding Reactor Pressure Vessel Integrity at Donald C. Cook Nuclear Plant, Unit 1, TAC No. MA0539," dated November 16, 1998.

6. Memorandum from Keith R. Wichman to Edmund J. Sullivan, "Meeting Summary for November 12, 1997 Meeting with Owners Group Representatives and NEI Regarding Review of Responses to Generic Letter 92-01, Revision 1, Supplement 1 Responses,"" dated November 19, 1997.

7. "Evaluation of the 1P3571 Weld Metal from the Surveillance Programs for Kewaunee and Maine Yankee," WCAP-15074, September 1998.

8. 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," Federal Register, Volume 60, Number 243, dated December 19, 1995.

Table 1. CEOG Chemistry data for Weld Wire Heat No. 1P3571

Summary of Properties for Weld Wire Heat No. 1P3571

Source: CEOG CE NPSD-1039 Revision 2

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.17	.51	KWE, Supp. "V"	WPS, 8/21/95	WDC-0426	b
1P3571	Linde 1092	3958	.15	.54	KWE, Supp. "P"	WPS, 8/21/95	WDC-0427	b
1P3571	Linde 1092	3958	.17	.61	KWE, Supp. "V"	WPS, 8/21/95	WDC-0428	b
1P3571	Linde 1092	3958	.17	.64	KWE, Supp. "R"	WPS, 8/21/95	WDC-0429	b
1P3571	Linde 1092	3958	.18	.67	KWE, Supp. "R"	WPS, 8/21/95	WDC-0430	b
1P3571	Linde 1092	3958	.19	.67	KWE, Supp. "V"	WPS, 8/21/95	WDC-0431	b
1P3571	Linde 1092	3958	.19	.67	KWE, Supp. "P"	WPS, 8/21/95	WDC-0432	b
1P3571	Linde 1092	3958	.186	.689	KWE, Supp. "S"	WPS, 8/21/95	WDC-0433	b
1P3571	Linde 1092	3958	.20	.70	KWE, Supp. "V"	WPS, 8/21/95	WDC-0434	b
1P3571	Linde 1092	3958	.19	.71	KWE, Supp. V"	WPS, 8/21/95	WDC-0435	b
1P3571	Linde 1092	3958	.172	.717	KWE, SC "P"	WCAP-13257	WDC-0436	b
1P3571	Linde 1092	3958	.34	.72	KWE, Supp. "R"	WCAP-13257	WDC-0437	b
1P3571	Linde 1092	3958	.22	.73	KWE, Surv. Test	WPS, 8/21/95	WDC-0438	b
CEOG Database				*1*				**9/10/97**

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 1. CEOG Chemistry data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.191	.734	KWE, SC "P"	WCAP-13257	WDC-0439	b
1P3571	Linde 1092	3958	.066	.736	KWE, SC "R"	WCAP-13257	WDC-0440	b
1P3571	Linde 1092	3958	.24	.74	KWE, Surv. Test	WPS, 8/21/95	WDC-0441	b
1P3571	Linde 1092	3958	.182	.742	KWE, SC "P"	WCAP-13257	WDC-0442	b
1P3571	Linde 1092	3958	.354	.742	KWE, SC "P"	WCAP-13257	WDC-0443	b
1P3571	Linde 1092	3958	.207	.769	KWE, SC "R"	WCAP-13257	WDC-0444	b
1P3571	Linde 1092	3958	.20	.77	KWE, SC Unirr.	WCAP-8107	WDC-0445	b
1P3571	Linde 1092	3958	.43	.78	KWE, Surv. Test	WPS, 8/21/95	WDC-0446	b
1P3571	Linde 1092	3958	.23	.79	KWE, Surv. Test	WPS, 8/21/95	WDC-0447	b
1P3571	Linde 1092	3958	.209	.795	KWE, Supp. "S"	WPS, 8/21/95	WDC-0448	b
1P3571	Linde 1092	3958	.22	.80	KWE, Surv. Test	WPS, 8/21/95	WDC-0449	b
1P3571	Linde 1092	3958	.434	.80	KWE, SC "V"	WCAP-13257	WDC-0450	b
1P3571	Linde 1092	3958	.196	.803	KWE, Supp. "S"	WPS, 8/21/95	WDC-0451	b
1P3571	Linde 1092	3958	.214	.816	KWE, SC "V"	WCAP-13257	WDC-0452	b

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 1. CEOG Chemistry data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.223	.871	KWE, Supp. "S"	WCAP-13257	WDC-0453	b
1P3571	Linde 1092	3958	.25	.66	MY, SC 263 deg.	BCL-585-21	WDC-0454	c
1P3571	Linde 1092	3958	.25	.70	MY, SC 263 deg.	BCL-585-21	WDC-0455	c
1P3571	Linde 1092	3958	.33	.70	MY, SC 263 deg.	BCL-585-21	WDC-0456	c
1P3571	Linde 1092	3958	.33	.71	MY, SC 263 deg.	BCL-585-21	WDC-0457	c
1P3571	Linde 1092	3958	.356	.728	MY, SC 253 deg.	WCAP-12819	WDC-0458	c
1P3571	Linde 1092	3958	.432	.745	MY, SC 253 deg.	WCAP-12819	WDC-0460	c
1P3571	Linde 1092	3958	.365	.78	MY, SC Unirr.	CR-75-269	WDC-0463	c
1P3571	Linde 1092	3958	.34	.73	MY, Supp. C04-01	WPS, 8/21/95	WDC-0468	c
1P3571	Linde 1092	3958	.30	.76	MY, Supp. C04-11	WPS, 8/21/95	WDC-0469	c
1P3571	Linde 1092	3958	.35	.76	MY, Supp. C04-02	WPS, 8/21/95	WDC-0470	c
1P3571	Linde 1092	3958	.33	.77	MY, Supp. C04-05	WPS, 8/21/95	WDC-0471	c
1P3571	Linde 1092	3958	.31	.78	MY, Supp. C04-07	WPS, 8/21/95	WDC-0472	c
1P3571	Linde 1092	3958	.32	.78	MY, Supp. C04-08	WPS, 8/21/95	WDC-0473	c

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 1. CEOG Chemistry data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.32	.78	MY, Supp. C04-09	WPS, 8/21/95	WDC-0474	c
1P3571	Linde 1092	3958	.32	.78	MY, Supp. C04-10	WPS, 8/21/95	WDC-0475	c
1P3571	Linde 1092	3958	.33	.78	MY, Supp. C04-04	WPS, 8/21/95	WDC-0476	c
1P3571	Linde 1092	3958	.37	.80	MY, Supp. C04-01	WPS, 8/21/95	WDC-0477	c
1P3571	Linde 1092	3958	.38	.80	MY, Supp. C04-13	WPS, 8/21/95	WDC-0478	c
1P3571	Linde 1092	3958	.52	.80	MY, Supp. C04-15	WPS, 8/21/95	WDC-0479	c
1P3571	Linde 1092	3958	.53	.81	MY, Supp. C04-09	WPS, 8/21/95	WDC-0480	c
1P3571	Linde 1092	3958	.21	.88	C.E.	CEOG Database	WDC-0481	c
1P3571	Linde 1092	3958	.20	.73	LS1, SC 44U	GE-NE-A166-1294-R1	WDC-0483	d
1P3571	Linde 1092	3958	.22	.73	LS1, SC 44M	GE-NE-A166-1294-R1	WDC-0484	d
1P3571	Linde 1092	3958	.20	.74	LS1, SC 44LD	GE-NE-A166-1294-R1	WDC-0485	d
1P3571	Linde 1092	3958	.20	.75	LS1, SC 443	GE-NE-A166-1294-R1	WDC-0486	d
1P3571	Linde 1092	3958	.22	.75	LS1, SC 444	GE-NE-A166-1294-R1	WDC-0487	d
1P3571	Linde 1092	3958	.20	.76	LS1, SC 44A	GE-NE-A166-1294-R1	WDC-0488	d

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 1. CEOG Chemistry data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.22	.79	LS1, SC 447	GE-NE-A166-1294-R1	WDC-0490	d
1P3571	Linde 1092	3958	.21	.80	LS1, SC 45K	GE-NE-A166-1294-R1	WDC-0491	d
1P3571	Linde 1092	3958	.21	.80	LS1, SC 45M	GE-NE-A166-1294-R1	WDC-0492	d
1P3571	Linde 1092	3958	.22	.80	LS1, SC 45D	GE-NE-A166-1294-R1	WDC-0493	d
1P3571	Linde 1092	3958	.23	.82	LS1, SC 45E	GE-NE-A166-1294-R1	WDC-0494	d
1P3571	Linde 1092	3958	.22	.83	LS1, SC 44F	GE-NE-A166-1294-R1	WDC-0495	d
1P3571	Linde 1092	3958	.21	.78	LS1, SC Unirr.	WPS, 8/21/95	WDC-0496	d
1P3571	Linde 1092	3958		.76	HA1, SC	NEDC-30997	WDC-0497	e
1P3571	Linde 1092	3958	.28	.76	HA1, SC	NEDC-30997	WDC-0498	e
1P3571	Linde 1092	3958	.28	.76	HA1, SC	NEDC-30997	WDC-0499	e
1P3571	Linde 1092	3958	0.32	0.82	HA1, SC	NE-B1100691-01	WDC-1879	e
1P3571	Linde 1092	3958	0.32	0.87	HA1, SC	NE-B1100691-01	WDC-1880	e
1P3571	Linde 1092	3958	0.32	0.87	HA1, SC	NE-B1100691-01	WDC-1881	e

Note: WQ = Weld Qualification, SC = Surveillance Capsule, Supp. = Supplemental Test, Surv. = Surveillance Weld

Table 1. CEOG Chemistry data for Weld Wire Heat No. 1P3571

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
1P3571	Linde 1092	3958	.37	.75	C.E., WQ M1.43	CEOG Database	WDC-0500	f
1P3571	Linde 1092	3958	.40	.82	C.E., WQ M1.42	CEOG Database	WDC-0425	a
1P3571	Linde 80	0344	.22	.67	Wire/Flux Qual.	CEOG Database	WDC-0482	g

Best Estimate Cu = 0.283 wt% **Best Estimate Ni = 0.755 wt%** **Basis: Coil weighted Cu, weighted Ni**

Note: Using best-estimate chemistry, CF = 212.2 °F from Reg. Guide 1.99, Rev. 2 Tables

Table 2. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE I.D.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		Kewaunee, Single Arc				0.219	0.724	4
0.17	0.51	INDETERMINATE Ni	WDC-0426		b			
0.15	0.54	INDETERMINATE Ni	WDC-0427	MSE-MNA-229(95)	b			
0.17	0.61	VALID	WDC-0428		b			
0.17	0.64	VALID	WDC-0429		b			
0.18	0.67	VALID	WDC-0430		b			
0.19	0.67	VALID	WDC-0431		b			
0.19	0.67	VALID	WDC-0432	MSE-MNA-229(95)	b			
0.186	0.689	VALID	WDC-0433	MSE-MNA-229(95)	b			
0.20	0.70	VALID	WDC-0434		b			
0.19	0.71	VALID	WDC-0435	MSE-MNA-229(95)	b			
0.172	0.717	VALID	WDC-0436		b			
0.34	0.72	VALID	WDC-0437		b			
0.22	0.73	VALID	WDC-0438		b			
0.191	0.734	VALID	WDC-0439	WCAP-14280	b			
0.066	0.736	INDETERMINATE Cu?	WDC-0440		b			
0.24	0.74	VALID	WDC-0441		b			
0.182	0.742	VALID	WDC-0442		b			
0.354	0.742	VALID	WDC-0443		b			
0.207	0.769	VALID	WDC-0444		b			
0.2	0.77	VALID	WDC-0445		b			
0.43	0.78	VALID	WDC-0446		b			
0.23	0.79	VALID	WDC-0447		b			
0.209	0.795	VALID	WDC-0448	MSE-MNA-229(95)	b			
0.22	0.80	VALID	WDC-0449		b			
0.434	0.80	VALID	WDC-0450		b			
0.196	0.803	VALID	WDC-0451	MSE-MNA-229(95)	b			
0.21	0.816	VALID	WDC-0452		b			
0.223	0.871	VALID	WDC-0453	MSE-MNA-229(95)	b			

Table 2. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE I.D.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		Maine Yankee, Single Arc				0.351	0.771	4
0.25*	0.66*	INDETERMINATE	WDC-0454	BCL-585-21	c			
0.25*	0.70*	VALID	WDC-0455	BCL-585-21	c			
0.33**	0.70**	VALID	WDC-0456	BCL-585-21	c			
0.33**	0.71**	VALID	WDC-0457	BCL-585-21	c			
0.356	0.728	VALID	WDC-0458	WCAP-12819	c			
0.432	0.745	VALID	WDC-0460	WCAP-12819	c			
0.365	0.78	VALID	WDC-0463	D9693	c			
0.34	0.73	VALID	WDC-0468	D44441	c			
0.3	0.76	VALID	WDC-0469	D44449	c			
0.35	0.76	VALID	WDC-0470	D44440	c			
0.33	0.77	VALID	WDC-0471	D44443	c			
0.31	0.78	VALID	WDC-0472	D44445	c			
0.32	0.78	VALID	WDC-0473	D44446	c			
0.32	0.78	VALID	WDC-0474	D44447	c			
0.32	0.78	VALID	WDC-0475	D44448	c			
0.33	0.78	VALID	WDC-0476	D44442	c			
0.37	0.80	VALID	WDC-0477	D44439	c			
0.38	0.80	VALID	WDC-0478	D44451	c			
0.52	0.80	VALID	WDC-0479	D44453	c			
0.53	0.81	VALID	WDC-0480	D44452	c			
0.21***	0.88	VALID	WDC-0481	D44454	c			

* two measurements averaged to obtain single value for "best-estimate" evaluation

** two measurements averaged to obtain single value for "best-estimate" evaluation

*** measurement taken at interface with manual stick weld material

Table 2. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE LD.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		LaSalle-1, Tandem Arc				0.212	0.775	4
0.20	0.73	VALID	WDC-0483		d			
0.22	0.73	VALID	WDC-0484		d			
0.20	0.74	VALID	WDC-0485		d			
0.20	0.75	VALID	WDC-0486		d			
0.22	0.75	VALID	WDC-0487		d			
0.20	0.76	VALID	WDC-0488		d			
0.22	0.79	VALID	WDC-0490		d			
0.21	0.80	VALID	WDC-0491		d			
0.21	0.80	VALID	WDC-0492		d			
0.22	0.80	VALID	WDC-0493		d			
0.23	0.82	VALID	WDC-0494		d			
0.22	0.83	VALID	WDC-0495		d			
0.21	0.78	VALID	WDC-0496	D11341	d			
		Hatch-1, Tandem Arc				0.304	0.807	2
	0.76	VALID	WDC-0497	NEDC-30997	e			
0.28	0.76	VALID	WDC-0498	NEDC-30997	e			
0.28	0.76	VALID	WDC-0499	NEDC-30997	e			
0.32	0.82	INDETERMINATE	WDC-1879	NE-B1100691-01	e			
0.32	0.87	INDETERMINATE	WDC-1880	NE-B1100691-01	e			
0.32	0.87	INDETERMINATE	WDC-1881	NE-B1100691-01	e			

Table 2. Evaluation of Chemistry for Weld Wire Heat No. 1P3571

1P3571		Linde 1092 Type Flux				New Evaluation		
Cu	Ni	Flux Lot Number 3958				Avg. Cu	Avg. Ni	# of
wt%	wt%	CE PEDIGREE	SOURCE LD.	REPORT/ANALYSIS	Group Tag	wt%	wt%	Coils
		Weld Qualification, Tandem Arc				0.370	0.750	2
0.37	0.75	VALID	WDC-0500	D8698	f			
		Weld Qualification, Single Arc				0.400	0.820	1
0.40	0.82	VALID	WDC-0425	D8669	a			
		Weld Qualification, Linde 80 Flux Type				0.220	0.670	1
0.22	0.67	INVALID	WDC-0482	D19780	g	Note: Group Tag g data not used in analysis		

Coil Weighted Avg.
Cu
0.287 wt%

Simple Mean
Ni
0.756 wt%

Note: Using best-estimate chemistry, CF = 214.0 °F from Reg. Guide 1.99, Rev. 2 Tables

Table 3. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Summary of Properties for Weld Wire Heat No. 13253/12008

Source: CEOG CE NPSD-1039 Revision 2

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.22	.76	C.E.	CEOG Database	WDC-0155	b
13253/12008	Linde 1092	3791	.22	.76	C.E.	CEOG Database	WDC-0156	b
13253/12008	Linde 1092	3791	.22	.77	C.E.	CEOG Database	WDC-0158	b
13253/12008	Linde 1092	3791	.22	.77	C.E.	CEOG Database	WDC-0159	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0160	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0161	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0162	b
13253/12008	Linde 1092	3791	.22	.78	C.E.	CEOG Database	WDC-0163	b
13253/12008	Linde 1092	3791	.20	.86	C.E.	CEOG Database	WDC-0165	b
13253/12008	Linde 1092	3791	.20	.86	C.E.	CEOG Database	WDC-0166	b
13253/12008	Linde 1092	3791	.20	.87	C.E.	CEOG Database	WDC-0167	b

Table 3. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.20	.87	C.E.	CEOG Database	WDC-0168	b
13253/12008	Linde 1092	3791	.22	.87	C.E.	CEOG Database	WDC-0169	b
13253/12008	Linde 1092	3791	.20	.88	C.E.	CEOG Database	WDC-0170	b
13253/12008	Linde 1092	3791	.21	.88	C.E.	CEOG Database	WDC-0171	b
13253/12008	Linde 1092	3791	.21	.88	C.E.	CEOG Database	WDC-0172	b
13253/12008	Linde 1092	3791	.21	.88	C.E.	CEOG Database	WDC-0173	b
13253/12008	Linde 1092	3791	.22	.88	C.E.	CEOG Database	WDC-0174	b
13253/12008	Linde 1092	3791	.22	.88	C.E.	CEOG Database	WDC-0175	b
13253/12008	Linde 1092	3791	.22	.88	C.E.	CEOG Database	WDC-0176	b
13253/12008	Linde 1092	3791	.20	.89	C.E.	CEOG Database	WDC-0177	b
13253/12008	Linde 1092	3791	.20	.89	C.E.	CEOG Database	WDC-0178	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0179	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0180	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0181	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0182	b
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0183	b

Table 3. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.21	.89	C.E.	CEOG Database	WDC-0184	b
13253/12008	Linde 1092	3791	.22	.89	C.E.	CEOG Database	WDC-0185	b
13253/12008	Linde 1092	3791	.22	.89	C.E.	CEOG Database	WDC-0186	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0187	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0188	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0189	b
13253/12008	Linde 1092	3791	.20	.90	C.E.	CEOG Database	WDC-0190	b
13253/12008	Linde 1092	3791	.21	.90	C.E.	CEOG Database	WDC-0191	b
13253/12008	Linde 1092	3791	.21	.90	C.E.	CEOG Database	WDC-0192	b
13253/12008	Linde 1092	3791	.21	.90	C.E.	CEOG Database	WDC-0193	b
13253/12008	Linde 1092	3791	.22	.90	C.E.	CEOG Database	WDC-0194	b
13253/12008	Linde 1092	3791	.22	.90	C.E.	CEOG Database	WDC-0195	b
13253/12008	Linde 1092	3791	.20	.91	C.E	CEOG Database	WDC-0196	b
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0197	b
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0198	b

Table 3. CEOG Chemistry Data for Weld Wire Heat No. 13253/12008

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0199	b
13253/12008	Linde 1092	3791	.20	.91	C.E.	CEOG Database	WDC-0200	b
13253/12008	Linde 1092	3791	.21	.91	C.E.	CEOG Database	WDC-0201	b
13253/12008	Linde 1092	3791	.20	.92	C.E.	CEOG Database	WDC-0202	b
13253/12008	Linde 1092	3791	.20	.92	C.E.	CEOG Database	WDC-0203	b
13253/12008	Linde 1092	3791	.21	.92	C.E.	CEOG Database	WDC-0204	b
13253/12008	Linde 1092	3791; 3833	.24	.875	C.E.	CEOG Database	WDC-0205	b

Best Estimate Cu = 0.21 wt% **Best Estimate Ni = 0.873 wt%** **Basis: Simple mean Cu and Ni**

Note: Using best-estimate chemistry, CF = 208.7 °F from Reg. Guide 1.99, Rev. 2 Tables

Table 4. CEOG Chemistry Data for Weld Wire Heat No. 13253

Summary of Properties for Weld Wire Heat No. 13253

Source: CEOG CE NPSD-1039 Revision 2

Heat No.	Flux Type	Flux Lot	Pct. Cu	Pct. Ni	Data Source	Reference	Source I.D.	Group Tag
13253	Linde 1092	3774, 3883	.23	.71	PR-EDB	CEOG Database	WDC-0399	a
13253	Linde 1092	3774, 3883	.247	.728	PR-EDB	CEOG Database	WDC-0400	a
13253	Linde 1092	3774, 3883	.267	.728	PR-EDB	CEOG Database	WDC-0401	a
13253	Linde 1092	3774, 3883	.283	.732	PR-EDB	CEOG Database	WDC-0402	a
13253	Linde 1092	3774, 3883	.244	.734	PR-EDB	CEOG Database	WDC-0403	a
13253	Linde 1092	3791	.14	.72	C.E.	CEOG Database	WDC-0404	b
13253	Linde 1092	3791	.14	.74	C.E.	CEOG Database	WDC-0405	b
13253	Linde 1092	3791	.27	.74	PR-EDB	CEOG Database	WDC-0406	c

Best Estimate Cu = 0.221 wt% **Best Estimate Ni = 0.732 wt%** **Basis: Weighted mean Cu and Ni**

Note: Using best-estimate chemistry, CF = 189.1 °F from Reg. Guide 1.99, Rev. 2 Tables

Table 5. Surveillance Data for Weld Heat No. 1P3571

Plant	Capsule ID. (including source)	Cu (wt%)	Ni (wt%)	Irradiation Temperature (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
Kewaunee	V	0.219	0.724	532	.597 [a]	175 [a]	Y
Kewaunee	R	0.219	0.724	532	1.81 [a]	235 [a]	Y
Kewaunee	P	0.219	0.724	532	2.74 [a]	230 [a]	Y
Kewaunee	S	0.219	0.724	532	3.36 [a]	250 [a]	Y
Maine Yankee	W263	0.351	0.771	533	.567 [a]	222 [a]	Y
Maine Yankee	W253	0.351	0.771	542	1.25 [a]	260 [a]	Y
Maine Yankee	A25	0.351	0.771	522	1.76 [a]	270 [a]	Y
Maine Yankee	A35	0.351	0.771	533	7.13 [a]	345 [a]	Y
	Mean:	0.285	0.748	532.3			

Table $CF_{Kewaunee}$ = 187.2 °F, Table $CF_{Maine\ Yankee}$ = 237.3 °F, Table CF_{mean} = 211.9 °F

[a] from Ref. 7, "Evaluation of the 1P3571 Weld Metal from the Surveillance Programs for Kewaunee and Maine Yankee," WCAP-15074, September 1998.

Table 6. Adjustments to Surveillance Data for Weld Heat No. 1P3571

Plant	Capsule ID (including source)	Cu (wt%)	Ni (wt%)	Irradiation Temperature (°F)	Fluence Factor [a]	Measured ΔRT_{NDT} (°F)	Adjusted ΔRT_{NDT} [b] (°F)	Predicted ΔRT_{NDT} [c] (°F)	(Adjusted - Predicted) ΔRT_{NDT} (°F)
Kewaunee	V	0.219	0.724	532	0.856	175	198.4	185.2	13.2
Kewaunee	R	0.219	0.724	532	1.163	235	266.3	251.7	14.6
Kewaunee	P	0.219	0.724	532	1.269	230	260.7	274.7	-14.0
Kewaunee	S	0.219	0.724	532	1.317	250	283.3	285.1	-1.9
Maine Yankee	W263	0.351	0.771	533	0.841	222	197.5	182.1	15.4
Maine Yankee	W253	0.351	0.771	542	1.062	260	222.5	229.9	-7.5
Maine Yankee	A25	0.351	0.771	522	1.155	270	251.4	250.1	1.3
Maine Yankee	A35	0.351	0.771	533	1.466	345	307.4	317.3	-9.9

[a] Fluence Factor (FF) = $\text{fluence}^{(0.28 - 0.10 \log(\text{fluence}))}$ for fluence values shown in Table 5

[b] Adjusted $\Delta RT_{NDT} = \left(\frac{\text{Table } CF_{Mean}}{\text{Table } CF_{Capsule}} \right) * \text{Measured } \Delta RT_{NDT} + (T_{irr\ Mean} - T_{irr\ Capsule})$

[c] Predicted $\Delta RT_{NDT} = FF * CF$

where $CF = \Sigma (FF * \Delta RT_{NDT}) \div \Sigma (FF^2) = 2326.78 \div 10.749 = 216.5$ °F

Table 7. Information Requested on RPV Weld Materials for PTS Evaluation

Facility: D. C. Cook 1
Vessel Manufacturer: Combustion Engineering
32 EFPY Peak (ID) Fluence: 1.41×10^{19} n/cm^2
32 EFPY Axial Weld (ID) Fluence: 9.5×10^{18} n/cm^2

RPV Weld Wire Heat [1]	Best-Estimate Copper (wt%)	Best-Estimate Nickel (wt%)	EOL ID Fluence ($\times 10^{19}$) (n/cm^2)	Assigned Material Chemistry Factor (CF) (°F)	Method of Determining CF[2] (°F)	Initial RT_{NDT} ($RT_{NDT(U)}$) (°F)	σ_I (°F)	σ_Δ (°F)	Margin (°F)	RT_{PTS} at EOL (°F)
13253/12008	0.21	0.873	0.95	208.7	Tables	-56	17	28	66	215.7
1P3571	0.287	0.756	1.41	218.6[3]	Surv. Data	-56	17	14	44	227.4

(1) weld heat number or the material identification of the limiting material
(2) determined from tables or from surveillance data
(3) ratio adjusted CF value to account for chemistry differences between the capsule materials and the vessel:

$$\text{Ratio Adjusted CF} = 216.5 * \left(\frac{CF_{\text{Table, Vessel Chem.}}}{CF_{\text{Table, Surv. Chem.}}} \right) = 216.5 * \left(\frac{214.0}{211.9} \right) = 218.6\ ^\circ\text{F}$$

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat

Weld Wire Heat	Discussion
13253/12008	Simple mean Cu and Ni (see Table 3)
1P3571	Coil-weighted Cu, simple mean Ni (see Table 2)

Table 8. RT_{PTS} Values for D. C. Cook 1 Vessel Beltline Materials

Utility PTS Summary Report for D. C. Cook 1

Basis for Calculation of RT_{PTS} Values in Reactor Vessel Beltline Materials

Material Beltline I.D.	Heat No.	IRT_{NDT}(F)	CF (F)	EOL Fluence	FF	ΔRT_{NDT} (F)	MARGIN (F)	RTPTS (F)
Int. Shell Axial Welds 2-442 A,B&C	13253/12008	-56	208.7	9.5E+18	0.9856	205.7	66	215.7
Int. Shell Plate B4406-1	C1260	5	81.4	1.41E+19	1.095	89.2	34	128.2
Int. Shell Plate B4406-2	C3506	33	104.5	1.41E+19	1.095	114.5	34	181.5
Int. Shell Plate B4406-3	C3506	40	104	1.41E+19	1.095	113.9	34	187.9
Int. to Lower Shell Circ. Weld 9-442	1P3571	-56	218.6* ~~208.7~~	1.41E+19	1.095	239.4* ~~228.6~~	44* ~~66~~	227.4* ~~238.6~~
Lower Shell Axial Welds 3-442 A,B&C	13253/12008	-56	208.7	9.5E+18	0.9856	205.7	66	215.7
Lower Shell Plate B4407-1	C3929	28	97.8	1.41E+19	1.095	107.1	34	169.1
Lower Shell Plate B4407-2	C3932	-12	82.8	1.41E+19	1.095	90.7	34	112.7
Lower Shell Plate B4407-3	C3929	38	95.5	1.41E+19	1.095	104.6	34	176.6

* revised values

Attachment 3 to C0699-01

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