Commonwealth Edison Company
1400 Opus Place
Downers Grove, IL 60515-5701

ComEd

September 3, 1998

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555 - 0001

Byron Station, Units 1 and 2
Facility Operating Licenses NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Braidwood Station, Units 1 and 2
Facility Operating Licenses NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Subject: Response to Request for Additional Information Regarding Reactor Pressure Vessel

Reference: Letter from J. B. Hickman (U. S. Nuclear Regulatory Commission) to O. D. Kingsley (Commonwealth Edison Company) "Request for Additional Information Regarding Reactor Pressure Vessel Integrity at Braidwood, Unit Nos. 1 and 2 and Byron, Unit Nos. 1 and 2" letter dated June 1, 1998.

The purpose of this letter is to provide the response to the referenced request for additional information (RAI). The information and tabular summary requested in Sections 1.0, 2.0, and 3.0 of the RAI are contained in an attachment to this letter.

Based on the information contained in the attachment, Commonwealth Edison (ComEd) Company has concluded that the currently licensed Pressure-Temperature and Low Temperature Overpressure Protection limits for Braidwood Station, Units 1 and 2, and Byron Station, Units 1 and 2, do not require revision.

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Please address any comments or questions regarding this matter to Mr. David J. Chrzanowski at (630) 663-7205.

Respectfully,

R. M. Krich
Vice President - Regulatory Services

Attachment: Response to request for additional information regarding reactor pressure vessel integrity

cc: Regional Administrator - USNRC, Region III
NRC Senior Resident Inspector - Braidwood Station
NRC Senior Resident Inspector - Byron Station

ATTACHMENT

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING REACTOR PRESSURE VESSEL INTEGRITY

REQUEST FOR ADDITIONAL INFORMATION

Based on information received in Reference 1, in accordance with the provisions of Generic Letter 92-01, Supplement 1, "Reactor Vessel Structural Integrity," the NRC requested the following information be provided for Byron Station Units 1 and 2, and Braidwood Station, Units 1 and 2.

Section 1.0: Assessment of Best-Estimate Chemistry

"1. An evaluation of the information in the reference above and an assessment of its applicability to the determination of the best-estimate chemistry for all 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 pressurized thermal shock/pressure-temperature (PTS/PT) limits 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 this RAI on the use of surveillance data when responding."

Section 2.0: Evaluation and Use of Surveillance Data

"2.0 That (1) the information listed in Table 2, Table 3, and the chemistry factor 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 your 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)."

Section 3.0: PTS/PT Limit Evaluation

"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 P-T and LTOP limits. The schedule should ensure that compliance with 10 CFR Part 50, Appendix G, is maintained."

RESPONSE

ComEd has performed a re-evaluation of reactor pressure vessel (RPV) beltline material chemistry values previously submitted as part of the current licensing basis and presented the results in each Table 1 for the units. These tables include the latest known best-estimate chemistry information for all beltline materials in the four ComEd Pressurized Water Reactor RPVs. The best-estimate chemistries provided in these tables were obtained from the information provided in support of the Byron Station Units 1 and 2, and Braidwood Station Units 1 and 2, Technical Specification Amendment request regarding pressure temperature curves (Reference 2). References 2 through 5 list the heat specific chemistry data considered, defined the material sources for these chemistry data, and determined the appropriate method for determining the best-estimate chemistry. Additional input information has been provided in these tables to ease understanding of the calculated reference temperature-pressurized thermal shock (RT_{PTS}) values and their comparison to the current licensing basis values. These tables include the calculation of the adjusted reference temperatures (ARTs) to assess the impact on the licensed pressure-temperature (PT) and low temperature overpressure protection (LTOP) limits. The footnotes, provided with each table, identify the references and the evaluation methods used to determine the best-estimate chemistry values.

Chemistry data with multiple material sources was evaluated using the means-of-sources approach. Babcock & Wilcox has determined this approach to be most appropriate for determining the best estimate chemistries. In applying this approach to a given weld wire heat, all available test results from separate and distinct test or production welds are averaged. The resulting average values for separate and distinct test or production welds are subsequently averaged to obtain the best estimate value. The mean-of-the-sources approach provides the most appropriate estimate of weld chemistry. This approach eliminates the inappropriate weighting effect which can result from widely varying numbers of analyses performed on individual weld blocks.

The requested surveillance data are presented in each Table 2 for the units. All surveillance capsule results for the heats of material in the Byron Station Units 1 and 2 and Braidwood Station Units 1 and 2 surveillance programs are included in these tables. Surveillance capsule chemistry data are defined from the mean of all chemistry analyses performed on the capsule source materials. The irradiation environments, i.e., irradiation temperatures, of the surveillance capsules at Byron Station Units 1 and 2 and Braidwood Station Units 1 and 2 were identical except for the second fuel cycle at Byron Station Unit 1. The temperature difference, detailed in Reference 3, for this single fuel cycle was considered to have an insignificant effect on the surveillance data. As confirmed by the NRC in Reference 6, no temperature adjustment was necessary to the surveillance capsule data.

The surveillance data credibility is evaluated for each unit and presented in each Table 3 for the units. For the surveillance weld credibility evaluations, the measured ΔRT_{NDT} values were adjusted for differences in the surveillance capsule chemistry values by the ratio of the chemistry factor for the mean chemistry of the surveillance capsules to the chemistry factor of each surveillance capsule. Once the surveillance data were determined to be credible, the weld chemistry factor was determined from the surveillance data, which had been normalized to the vessel weld chemistry by the ratio of the vessel chemistry factor to the chemistry factor of each surveillance capsule. These evaluations were consistent with the guidance provided in Reference 7.

The nozzle shell forgings and upper girth welds between the nozzle shell and the intermediate shell coarses were included in the evaluations provided in each Table 1 for the units. Although these vessel components are above the active fuel zone, the fluence values used to determine the RT_{PTS} values and adjusted reference temperatures (ARTs) were conservatively estimated by using the top of active fuel fluence. Using this conservative fluence value has yielded a conservative prediction of the RT_{PTS} and ART for these materials.

Examining the results presented in Table 1 for Byron Station Unit 1, the limiting material, based on the ART used in the PT and LTOP limits, is the intermediate shell forging, heat number 5P5933. The ART values for this material are the same as those used for determining the currently licensed PT and LTOP limits. However, the RT_{PTS} for the nozzle shell forging, heat number 123J218, is projected to be 2 °F higher than the intermediate shell forging at end-of-life. The nozzle shell forging RT_{PTS} of 82 °F remains well below the 10 CFR 50.61 screening criteria of 270 °F for forgings.

Examining the results presented in Table 1 for Byron Station Unit 2, the middle girth weld, heat number 442002, remains the limiting material based on the RT_{PTS} and ART for the PT and LTOP limits. The ART value for this material was determined to be less than the value used in the currently licensed PT and LTOP limits.

Examining the results presented in Table 1 for Braidwood Station Unit 1, the middle girth weld, heat number 442011, remains the limiting material based on the RT_{PTS} and ART for the PT and LTOP limits. The ART value for this material was determined to be less than the value used in the currently licensed PT and LTOP limits.

Examining the results presented in Table 1 for Braidwood Station Unit 2, the middle girth weld, heat number 442011, remains the limiting material based on the RT_{PTS} and ART for the PT and LTOP limits. The ART value for this material was determined to be equal to the value used in the currently licensed PT and LTOP limits.

In summary, the chemistry values for the beltline materials of the Byron Station Units 1 and 2 and Braidwood Station Units 1 and 2 RPVs were evaluated using the information provided in References 2 through 5. Based on this information, the best-estimate chemistry values were determined using the mean-of-the-sources approach for vessel materials with multiple chemistry data sources and the mean chemistry values for vessel materials with chemistry data from a single source. The results of this evaluation are documented in each Table 1 for the units. The requested surveillance capsule data from the Byron Station Units 1 and 2 and Braidwood each Table 2 for the units. Units 1 and 2 surveillance capsule programs were provided in each Table 2 for the units and evaluated in each Table 3 for the units. The results of the surveillance data evaluations were included in each Table 1 for the units. As seen from these tables, the ART for the PT and LTOP limits was reduced or remained unchanged for all of the RPVs. The RT_{PTS} limiting material for Byron Station Unit 2 and Braidwood Station Units 1 and 2 did not change. The Byron Station Unit 1 RT_{PTS} limiting material changed from the intermediate shell forging, RT_{PTS} = 80 °F, to the nozzle shell forging, RT_{PTS} = 82 °F. This RT_{PTS} is well below the 10 CFR 50.61 screening criteria of 270 °F for a forging. Consequently, the currently licensed PT and LTOP limits do not require revision.

References

1. M. DeVan letters to NRC dated June 6, 1997, (INS-97-2262), June 19,1997 (INS-97-2450), and July 10, 1997 (INS-97-2741).

2. H. G. Stanley letter to NRC dated January 8, 1998, transmitting "Supplemental Information Pertaining to Technical Specification Amendment Regarding Pressure Temperature Curves," Byron and Braidwood Nuclear Power Stations, Units 1 and 2.
Includes:

- Errata to "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824 Revision 2, (Westinghouse Letter CAE-97-233/CCE-97-316)
- Errata to "Byron Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14940, (Westinghouse Letter CAE-97-233/CCE-97-316)
- Errata to "Braidwood Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP- 14970, (Westinghouse Letter CAE-97-233/CCE-97-316)
- Errata to "Response to NRC Question to WCAP-14940, WCAP-14970 and 14824, Rev. 2," Westinghouse Letter CAE-97-231/CCE-97-314, dated January 6, 1998.

3. J. B. Hosmer letter to NRC dated December 3, 1997, transmitting "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP 14824, Revision 2 and Errata in Westinghouse Letters CAE-97-220/CCE-97-304

4. J. B. Hosmer letter to USNRC dated November 18, 1997, transmitting:

- "Byron Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14940, with Errata in Westinghouse Letter CAE-97-210/CCE-97-289.

- "Braidwood Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14970, with Errata in Westinghouse Letter CAE-97-210/CCE-97-289.

5. "Braidwood Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14243.

6. NRC letter to O. D. Kingsley, dated January 21, 1998, "Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2," Acceptance for Referencing of Pressure Temperature Limits Report.

7. NRC Memorandum from K. Wichman to E. Sullivan, dated November 19, 1997, " 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."

Byron Station Unit 1: Table 1

Vessel Manufacturer: Babcock & Wilcox

32 EFPY Peak ID Surface Fluence: 2.159E+19 n/cm^2

32 EFPY Upper Girth Weld ID Surface Fluence: 5.627E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	EOL ID Fluence (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	EOL ID ART or RT_{PTS} (°F)	Licensing Basis RT_{PTS}
Intermediate Shell Forging	5P-5933		0.0364	0.747	23.8	Table	40	2.159	1.209	28.8	0	14.4	28.8	98	
Credible Surveillance Data					19.0	Surv. Cap	40	2.159	1.209	23.0	0	8.5	17.0	80	80
Lower Shell Forging	5P-5951		0.04	0.64	26.0	Table	10	2.159	1.209	31.4	0	15.7	31.4	73	73
Middle Girth Weld WF-336	442002	8873	0.05	0.62	68.0	Table	-30	2.159	1.209	82.2	0	28.0	56.0	108	
Credible Surveillance Data					48.9	Surv. Cap	-30	2.159	1.209	59.2	0	14.0	28.0	57	73
Nozzle Shell Forging (2)	123J218		0.05	0.72	31.0	Table	30	0.563	0.839	26.0	0	13.0	26.0	82	
Upper Girth Weld WF-501 (2)	442011	8086	0.03	0.67	41.0	Table	10	0.563	0.839	34.4	0	17.2	34.4	79	
Credible Surveillance Data					17.0	Surv. Cap	10	0.563	0.839	14.3	0	7.1	14.3	39	

12 EFPY Peak ID Surface Fluence: 8.1E+18 n/cm^2

12 EFPY Upper Girth Weld ID Surface Fluence: 2.11E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	1/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	1/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging Credible Surveillance Data	5P-5933		0.0364	0.747	19.0	Surv. Cap	40	0.486	0.799	15.2	0	7.6	15.2	70	70
Lower Shell Forging	5P-5951		0.04	0.64	26.0	Table	10	0.486	0.799	20.8	0	10.4	20.8	52	52
Middle Girth Weld WF-336 Credible Surveillance Data	442002	8873	0.05	0.62	48.9	Surv. Cap	-30	0.486	0.799	39.1	0	14.0	28.0	37	47
Nozzle Shell Forging (2)	123J218		0.05	0.72	31.0	Table	30	0.127	0.466	14.4	0	7.2	14.4	59	59
Upper Girth Weld WF-501 (2)	442011	8086	0.03	0.67	17.0	Surv. Cap	10	0.127	0.466	7.9	0	4.0	7.9	26	26

Byron Station Unit 1: Table 1

12 EFPY Peak ID Surface Fluence: 8.1E+18 n/cm^2

12 EFPY Upper Girth Weld ID Surface Fluence: 2.11E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	3/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	3/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging Credible Surveillance Data	5P-5933		0.0364	0.747	19.0	Surv. Cap	40	0.175	0.538	10.2	0	5.1	10.2	60	60
Lower Shell Forging	5P-5951		0.04	0.64	26.0	Table	10	0.175	0.538	14.0	0	7.0	14.0	38	38
Middle Girth Weld WF-336 Credible Surveillance Data	442002	8873	0.05	0.62	48.9	Surv. Cap	-30	0.175	0.538	26.4	0	13.2	26.4	23	31
Nozzle Shell Forging (2)	123J218		0.05	0.72	31.0	Table	30	0.046	0.279	8.6	0	4.3	8.6	47	47
Upper Girth Weld WF-501 (2)	442011	8086	0.03	0.67	17.0	Surv. Cap	10	0.046	0.279	4.7	0	2.4	4.7	19	19

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.

(1) From Westinghouse Letter CAE-97-231/CCE-97-314 and WCAP-13880, 32 EFPY Fluence extrapolated from the 12 EFPY fluence of 2.11 x 10^{18} n/cm^2. This is the top of active fuel fluence which is conservative for evaluating the weld and base metal above it.

(2) Best estimate chemistry data from Westinghouse Letter CAE-97-231/CCE-97-314.

(3) Best Estimate chemistries were determined by the mean of the sources approach where multiple sources exist, and mean for single sources.

Byron Station Unit 1: Table 2

Intermediate Shell Forging 5P-5933 - Single Source:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BY-1	U (LT)	0.0364	0.747	(1)	0.372	0	Y
BY-1	U (TL)	0.0364	0.747	(1)	0.372	0	Y
BY-1	X (LT)	0.0364	0.747	(1)	1.39	30	Y
BY-1	X (TL)	0.0364	0.747	(1)	1.39	30	Y

(1) Surveillance data are from the vessel being assessed.

Middle Girth Weld WF-336, Heat # 442002, Multiple Sources:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BY-1	U	0.022	0.690	(2)	0.372	0	Y
BY-1	X	0.022	0.690	(2)	1.39	35	Y
BY-2	U	0.023	0.712	(2)	0.3996	0	Y
BY-2	W	0.023	0.712	(2)	1.211	30	Y

(2) Irradiation temperatures for Units 1 & 2 were the same except for the second fuel cycle at Byron Unit 1, which operated at a cold leg inlet temperature of 557°F while Byron Unit 2 operated at 551°F for the second fuel cycle. The effect of the 6°F difference on the ΔRT_{NDT} for a single fuel cycle is considered to be insignificant. No adjustment for irradiation temperature was included.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.

Byron Station Unit 1: Table 3

Intermediate Shell Forging 5P-5933, Single Source Credibility Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	Measured - Predicted ΔRT_{NDT} (°F)	FF x Measured ΔRT_{NDT}	FF^2
BY-1	U	0.0364	0.747	23.8	(1)	0.727	0	13.8	-13.8	0.00	0.53
BY-1	U	0.0364	0.747	23.8	(1)	0.727	0	13.8	-13.8	0.00	0.53
BY-1	X	0.0364	0.747	23.8	(1)	1.091	30	20.8	9.2	32.74	1.19
BY-1	X	0.0364	0.747	23.8	(1)	1.091	30	20.8	9.2	32.74	1.19
									Sum:	65.49	3.44
									Surveillance Chemistry Factor:	19.0	

(1) Surveillance data are from this vessel. No adjustment for irradiation temperature.

Credibility Criteria of 17 °F per Reg. Guide 1.99 Rev. 2 for base metal is met, therefore the surveillance data is credible and is used to determine the chemistry factor.

Intermediate Shell Forging 5P-5933, Single Source Chemistry Factor Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Fluence Factor	Measured ΔRT_{NDT} (°F) (2)	FF x ΔRT_{NDT}	FF^2
BY-1	U	0.0364	0.747	23.8	0.727	0	0.00	0.53
BY-1	U	0.0364	0.747	23.8	0.727	0	0.00	0.53
BY-1	X	0.0364	0.747	23.8	1.091	30	32.74	1.19
BY-1	X	0.0364	0.747	23.8	1.091	30	32.74	1.19
						Sum:	65.49	3.44
						Surveillance Chemistry Factor:	19.0	

Byron Station Unit 1: Table 3

Middle Girth Weld WF-336, Heat # 442002, Multiple Source Credibility Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Adjusted (2) ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	(Adjusted - Predicted) ΔRT_{NDT} (°F)	FF x Adjusted ΔRT_{NDT}	FF^2
BY-1	U	0.022	0.690	29.8	(1)	0.727	0	0.0	15.0	-15.0	0.00	0.53
BY-1	X	0.022	0.690	29.8	(1)	1.091	35	35.8	22.6	13.3	39.10	1.19
BY-2	U	0.023	0.712	31.2	(1)	0.746	0	0.0	15.4	-15.4	0.00	0.56
BY-2	W	0.023	0.712	31.2	(1)	1.053	30	29.3	21.8	7.5	30.89	1.11
Surveillance Ave.:		0.0225	0.701	30.5						Sum:	69.99	3.38
										Slope $_{Best\ Fit}$:	20.7	

(1) Irradiation temperatures for Units 1 & 2 were the same except for the second fuel cycle at Byron Unit 1, which operated at a cold leg inlet temperature of 557°F while Byron Unit 2 operated at 551°F for the second fuel cycle. The effect of the 6°F difference on the ΔRT_{NDT} for a single fuel cycle is considered to be insignificant. No adjustment for irradiation temperature were included.
(2) Adjusted for surveillance capsule chemical composition differences.
Credibility Criteria of 28 °F per Reg. Guide 1.99 Rev. 2 for weld metal is met, therefore the surveillance data is credible and is used to determine the chemistry factor.

Middle Girth Weld WF-336, Heat # 442002, Multiple Source Vessel Weld Chemistry Factor:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Adjusted (2) ΔRT_{NDT} (°F)			FF x Adjusted ΔRT_{NDT}	FF^2
BY-1	U	0.022	0.690	29.8	(1)	0.727	0	0.0			0.00	0.53
BY-1	X	0.022	0.690	29.8	(1)	1.091	35	84.8			92.55	1.19
BY-2	U	0.023	0.712	31.2	(1)	0.746	0	0.0			0.00	0.56
BY-2	W	0.023	0.712	31.2	(1)	1.053	30	69.4			73.13	1.11
Vessel Weld Ave.:		0.053	0.621	72.2						Sum:	165.68	3.38
										Surveillance Data Chemistry Factor:	48.9	

(1) Irradiation temperatures for Units 1 & 2 were the same except for the second fuel cycle at Byron Unit 1, which operated at a cold leg inlet temperature of 557°F while Byron Unit 2 operated at 551°F. The effect of the 6°F difference on the ΔRT_{NDT} for a single fuel cycle is considered to be insignificant. No adjustment for irradiation temperature was included.
(2) Adjusted for vessel chemical composition differences with the surveillance capsules.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.

Byron Station Unit 2: Table 1

Vessel Manufacturer: Babcock & Wilcox

32 EFPY Peak ID Surface Fluence: 2.192E+19 n/cm^2

32 EFPY Upper Girth Weld ID Surface Fluence: 4.613E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	EOL ID Fluence (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	EOL ID ART or RT_{PTS} (°F)	Licensing Basis RT_{PTS}
Intermediate Shell Forging	49D329-1-1/ 49C297-1-1		0.01	0.7	20.0	Table	-20	2.192	1.213	24.3	0	12.1	24.3	29	29
Lower Shell Forging	49D330-1-1/ 49C298-1-1		0.05	0.71	32.2	Table	-20	2.192	1.213	39.1	0	17.0	34.0	53	53
Middle Girth Weld WF-447	442002	8064	0.05	0.62	68.0	Table	10	2.192	1.213	82.5	0	28.0	56.0	148	
Credible Surveillance Data	442002				48.9	Surv. Cap	10	2.192	1.213	59.4	0	14.0	28.0	97	113
Nozzle Shell Forging (2)	4P-6107		0.05	0.74	31.0	Table	10	0.461	0.785	24.3	0	12.2	24.3	59	
Upper Girth Weld WF-562 (2)	442011	8061	0.03	0.67	41.0	Table	40	0.461	0.785	32.2	0	16.1	32.2	104	
Credible Surveillance Data	442011				17.0	Surv. Cap.	40	0.461	0.785	13.3	0	6.7	13.3	67	

12 EFPY Peak ID Surface Fluence: 8.22E+18 n/cm^2

12 EFPY Upper Girth Weld ID Surface Fluence: 1.73E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	1/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	1/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging	49D329-1-1/ 49C297-1-1		0.01	0.7	20.0	Table	-20	0.494	0.803	16.1	0	8.0	16.1	12	12
Lower Shell Forging	49D330-1-1/ 49C298-1-1		0.05	0.71	32.2	Table	-20	0.494	0.803	25.9	0	12.9	25.9	32	32
Middle Girth Weld WF-447	442002	8064	0.05	0.62	48.9	Surv. Cap	10	0.494	0.803	39.3	0	14.0	28.0	77	88
Nozzle Shell Forging (2)	4P-6107		0.05	0.74	31.0	Table	10	0.104	0.425	13.2	0	6.6	13.2	36	36
Upper Girth Weld WF-562 (2)	442011	8061	0.03	0.67	41.0	Table	40	0.104	0.425	17.4	0	8.7	17.4	75	75
Credible Surveillance Data	442011				17.0	Surv. Cap.	40	0.104	0.425	7.2	0	3.6	7.2	54	54

Byron Station Unit 2: Table 1

12 EFPY Peak ID Surface Fluence: 8.22E+18 n/cm^2

12 EFPY Upper Girth Weld ID Surface Fluence: 1.73E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	3/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_i	σ_Δ	Margin (°F)	3/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging	49D329-1-1/ 49C297-1-1		0.01	0.7	20.0	Table	-20	0.178	0.542	10.8	0	5.4	10.8	2	2
Lower Shell Forging	49D330-1-1/ 49C298-1-1		0.05	0.71	32.2	Table	-20	0.178	0.542	17.4	0	8.7	17.4	15	15
Middle Girth Weld WF-447	442002	8064	0.05	0.62	48.9	Surv. Cap	10	0.178	0.542	26.5	0	13.3	26.5	63	72
Nozzle Shell Forging (2)	4P-6107		0.05	0.74	31.0	Table	10	0.037	0.250	7.7	0	3.9	7.7	25	26
Upper Girth Weld WF-562 (2)	442011	8061	0.03	0.67	41.0	Table	40	0.037	0.250	10.2	0	5.1	10.2	60	61
Credible Surveillance Data	442011				17.0	Surv. Cap.	40	0.037	0.250	4.2	0	2.1	4.2	48	48

Reference: "Byron Unit 2 Heatup and Cooldown Limit Curves for Normal Operation ," WCAP-14940, Revision 0, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-232/CCE-97-315.

(1) From Westinghouse Letter CAE-97-231/CCE-97-314 and WCAP-14064: 32 EFPY Fluence extrapolated from the 12 EFPY fluence of 1.73 x 10^{18} n/cm^2. This is the top of active fuel fluence which is conservative for evaluating the weld and base metal above it.

(2) Best estimate chemistry data from Westinghouse Letter CAE-97-231/CCE-97-314.

(3) Best Estimate chemistries were determined by the mean of the sources approach where multiple sources exist, and mean for single sources.

Byron Station Unit 2: Table 2

Lower Shell Forging 49D330-1-1/49C298-1-1, Single Source:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BY-2	U (LT)	0.05	0.71	(1)	0.3996	0	Y
BY-2	U (TL)	0.05	0.71	(1)	0.3996	25	Y
BY-2	W (LT)	0.05	0.71	(1)	1.211	5	Y
BY-2	W (TL)	0.05	0.71	(1)	1.211	40	Y

(1) Surveillance data are from the vessel being assessed.

Middle Girth Weld WF-447, Heat # 442002, Multiple Sources:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BY-1	U	0.022	0.690	(2)	0.372	0	Y
BY-1	X	0.022	0.690	(2)	1.39	35	Y
BY-2	U	0.023	0.712	(2)	0.3996	0	Y
BY-2	W	0.023	0.712	(2)	1.211	30	Y

(2) Irradiation temperatures for Units 1 & 2 were the same except for the second fuel cycle at Byron Unit 1, which operated at a cold leg inlet temperature of 557°F while Byron Unit 2 operated at 551°F for the second fuel cycle. The effect of the 6°F difference on the ΔRTNDT for a single fuel cycle is considered to be insignificant. No adjustment for irradiation temperature was included.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.
Reference: "Byron Unit 2 Heatup and Cooldown Limit Curves for Normal Operation ," WCAP-14940, Revision 0, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-232/CCE-97-315.

Byron Station Unit 2: Table 3

Lower Shell Forging 49D330-1-1/49C298-1-1, Single Source:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	Measured - Predicted ΔRT_{NDT} (°F)	FF x ΔRT_{NDT}	FF^2
BY-2	U	0.05	0.71	32.2	(1)	0.746	0	14.8	-14.8	0.00	0.56
BY-2	U	0.05	0.71	32.2	(1)	0.746	25	14.8	10.2	18.64	0.56
BY-2	W	0.05	0.71	32.2	(1)	1.053	5	20.9	-15.9	5.27	1.11
BY-2	W	0.05	0.71	32.2	(1)	1.053	40	20.9	19.1	42.14	1.11
									Sum:	66.05	3.33
									Surveillance Chemistry Factor:	19.8	

(1) Surveillance data are from this vessel. No adjustment for irradiation temperature.
Credibility Criteria of 17 °F in Reg. Guide 1.99 Rev. 2 for base metal is exceeded, therefore the surveillance data is not credible.

Lower Shell Forging 49D330-1-1/49C298-1-1, Assess Chemistry Factor for Conservatism:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	Measured Predicted ΔRT_{NDT} (°F)
BY-2	U	0.05	0.71	32.2	0.746	0	24.0	-24.0
BY-2	U	0.05	0.71	32.2	0.746	25	24.0	1.0
BY-2	W	0.05	0.71	32.2	1.053	5	33.9	-28.9
BY-2	W	0.05	0.71	32.2	1.053	40	33.9	6.1

Reg. Guide 1.99 Rev. 2, Table chemistry factor is considered conservative because these differences are less than +/- 34°F.

See Byron Unit 1 Table 3 for Middle Girth Weld WF-447, Heat # 442002 Credibility Determination and Vessel Weld Chemistry Factor:

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316. "Byron Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14940, Revision 0, with Errata in Westinghouse Letter CAE-97-220/CCE-97-304.

Braidwood Station Unit 1: Table 1

Vessel Manufacturer: Babcock & Wilcox

32 EFPY Peak ID Surface Fluence: 2.239E+19 n/cm^2

32 EFPY Upper Girth Weld ID Surface Fluence: 4.980E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	EOL ID Fluence (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	EOL ID ART or RT_{PTS} (°F)	Licensing Basis RT_{PTS}
Intermediate Shell Forging	49D383-1-1/ 49C344-1-1		0.05	0.73	31.0	Table	-30	2.239	1.218	37.8	0	17.0	34.0	42	42
Lower Shell Forging	49D867-1-1/ 49C813-1-1		0.04	0.74	26.0	Table	-20	2.239	1.218	31.7	0	15.8	31.7	43	
Credible Surveillance Data					18.8	Surv. Cap	-20	2.239	1.218	22.9	0	8.5	17.0	20	20
Middle Girth Weld WF-562	442011	8061	0.03	0.67	41.00	Table	40	2.239	1.218	50.0	0	25.0	50.0	140	
Credible Surveillance Data					17.0	Surv. Cap	40	2.239	1.218	20.7	0	10.4	20.7	81	81
Nozzle Shell Forging (2)	5P-7016		0.04	0.71	26.0	Table	10	0.498	0.805	20.9	0	10.5	20.9	52	
Upper Girth Weld WF-645 (2)	H4498	261	0.042	0.46	57.0	Table	-25	0.498	0.805	45.9	0	23.0	45.9	67	

16 EFPY Peak ID Surface Fluence: 1.12E+19 n/cm^2

16 EFPY Upper Girth Weld ID Surface Fluence: 2.49E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	1/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	1/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging	49D383-1-1/ 49C344-1-1		0.05	0.73	31.0	Table	-30	0.673	0.889	27.6	0	13.8	27.6	25	25
Lower Shell Forging Credible Surveillance Data	49D867-1-1/ 49C813-1-1		0.04	0.74	18.8	Surv. Cap	-20	0.673	0.889	16.7	0	8.4	16.7	13	13
Middle Girth Weld WF-562	442011	8061	0.03	0.67	17.0	Surv. Cap	40	0.673	0.889	15.1	0	7.6	15.1	70	77
Nozzle Shell Forging (2)	5P-7016		0.04	0.71	26.0	Table	10	0.150	0.502	13.1	0	6.5	13.1	36	36
Upper Girth Weld WF-645 (2)	H4498	261	0.042	0.46	57.0	Table	-25	0.150	0.502	28.6	0	14.3	28.6	32	32

Braidwood Station Unit 1: Table 1

16 EFPY Peak ID Surface Fluence: 1.12E+19 n/cm^2

16 EFPY Upper Girth Weld ID Surface Fluence: 2.49E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	3/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	3/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging	49D383-1-1/ 49C344-1-1		0.05	0.73	31.0	Table	-30	0.243	0.616	19.1	0	9.6	19.1	8	8
Lower Shell Forging Credible Surveillance Data	49D867-1-1/ 49C813-1-1		0.04	0.74	18.8	Surv. Cap	-20	0.243	0.616	11.6	0	5.8	11.6	3	3
Middle Girth Weld WF-562	442011	8061	0.03	0.67	17.0	Surv. Cap	40	0.243	0.616	10.5	0	5.2	10.5	61	65
Nozzle Shell Forging (2)	5P-7016		0.04	0.71	26.0	Table	10	0.054	0.305	7.9	0	4.0	7.9	26	26
Upper Girth Weld WF-645 (2)	H4498	261	0.042	0.46	57.0	Table	-25	0.054	0.305	17.4	0	8.7	17.4	10	10

References: "Braidwood Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14243.
Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood, WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.

(1) From Westinghouse Letter CAE-97-231/CCE-97-314 and WCAP-14241: 32 EFPY Fluence extrapolated from the 16 EFPY fluence of 2.49 x 10^{18} n/cm^2. This is the top of active fuel fluence which is conservative for evaluating the weld and base metal above it.
(2) Best estimate chemistry data from Westinghouse LetterCAE-97-231/CCE-97-314.
(3) Best Estimate chemistries were determined by the mean of the sources approach where multiple sources exist, and mean for single sources.

Braidwood Station Unit-1: Table 2

Lower Shell Forging 49D867-1-1/49C813-1-1, Single Source:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BR-1	U (LT)	0.04	0.74	(1)	0.3814	5	Y
BR-1	U (TL)	0.04	0.74	(1)	0.3814	0	Y
BR-1	X (LT)	0.04	0.74	(1)	1.144	30	Y
BR-1	X (TL)	0.04	0.74	(1)	1.144	25	Y

(1) Surveillance data are from the vessel being assessed.

Middle Girth Weld WF-562, Heat # 442011, Multiple Sources:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BR-1	U	0.032	0.671	(1)	0.3814	10	Y
BR-1	X	0.032	0.671	(1)	1.144	25	Y
BR-2	U	0.033	0.708	(1)	0.3933	0	Y
BR-2	X	0.033	0.708	(1)	1.126	20	Y

(1) Irradiation temperatures for Braidwood Units 1 & 2 surveillance data were identical.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.

Braidwood Station Unit 1: Table 3

Lower Shell Forging 49D867-1-1/49C813-1-1, Single Source Credibility Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	(Measured - Predicted) ΔRT_{NDT} (°F)	FF x Measured ΔRT_{NDT}	FF^2
BR-1	U	0.04	0.74	26.0	(1)	0.733	5	13.8	-8.8	3.67	0.54
BR-1	U	0.04	0.74	26.0	(1)	0.733	0	13.8	-13.8	0.00	0.54
BR-1	X	0.04	0.74	26.0	(1)	1.038	30	19.5	10.5	31.13	1.08
BR-1	X	0.04	0.74	26.0	(1)	1.038	25	19.5	5.5	25.94	1.08
									Sum:	60.73	3.23
									Surveillance Chemistry Factor:	18.8	

(1) Surveillance data are from this vessel. No adjustment for irradiation temperature.

Credibility Criteria of 17 °F per Reg. Guide 1.99 Rev. 2 for base metal is met, therefore the surveillance data is credible and is used to determine the chemistry factor.

Lower Shell Forging 49D867-1-1/49C813-1-1, Single Source Chemistry Factor Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Fluence Factor	Measured ΔRT_{NDT} (°F)	FF x Measured ΔRT_{NDT}	FF^2
BR-1	U	0.04	0.74	26.0	0.733	5	3.67	0.54
BR-1	U	0.04	0.74	26.0	0.733	0	0.00	0.54
BR-1	X	0.04	0.74	26.0	1.038	30	31.13	1.08
BR-1	X	0.04	0.74	26.0	1.038	25	25.94	1.08
						Sum:	60.73	3.23
						Vessel Chemistry Factor:	18.8	

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316. "Braidwood Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14243.

Braidwood Station Unit 1: Table 3

Middle Girth Weld WF-562, Heat # 442011, Multiple Source Credibility Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Adjusted ΔRT_{NDT} (°F) (2)	Predicted ΔRT_{NDT} (°F)	(Adjusted - Predicted) ΔRT_{NDT} (°F)	FF x Adjusted ΔRT_{NDT}	FF^2
BR-1	U	0.032	0.671	43.60	(1)	0.733	10	10.3	12.5	-2.2	7.55	0.54
BR-1	X	0.032	0.671	43.60	(1)	1.038	25	25.7	17.6	8.1	26.71	1.08
BR-2	U	0.033	0.708	44.90	(1)	0.741	0	0.0	12.6	-12.6	0.00	0.55
BR-2	X	0.033	0.708	44.90	(1)	1.033	20	20.0	17.6	2.4	20.66	1.07
Surveillance Ave.:		0.033	0.690	44.90						Sum:	54.93	3.23
										Slope Best Fit:	17.0	

(1) Irradiation temperatures for Braidwood Units 1 & 2 surveillance data were identical. No irradiation temperature adjustment is required.
(2) Adjusted for surveillance capsule chemical composition differences.

Credibility Criteria of 28 °F per Reg. Guide 1.99 Rev. 2 for weld metal is met, therefore the surveillance data is credible, and is used to determine the chemistry factor.

Middle Girth Weld WF-562, Heat # 442011, Multiple Source Vessel Weld Chemistry Factor:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Adjusted ΔRT_{NDT} (°F) (2)	FF x Adjusted ΔRT_{NDT}	FF^2
BR-1	U	0.032	0.671	43.60	(1)	0.733	10	10.3	7.55	0.54
BR-1	X	0.032	0.671	43.60	(1)	1.038	25	25.7	26.71	1.08
BR-2	U	0.033	0.708	44.90	(1)	0.741	0	0.0	0.00	0.55
BR-2	X	0.033	0.708	44.90	(1)	1.033	20	20.0	20.66	1.07
Vessel Weld Ave.:		0.033	0.667	44.90				Sum:	54.93	3.23
								Vessel Chemistry Factor:	17.0	

(1) Irradiation temperatures for Braidwood Units 1 & 2 surveillance data and vessel were identical. No irradiation temperature adjustment is required.
(2) Adjusted for vessel chemical composition differences.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316. "Braidwood Unit 1 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14243.

Braidwood Station Unit 2: Table 1

Vessel Manufacturer: Babcock & Wilcox

32 EFPY Peak ID Surface Fluence: 2.199E+19 n/cm^2

32 EFPY Upper Girth Weld ID Surface Fluence: 4.347E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	EOL ID Fluence (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	EOL ID ART or RT_{PTS} (°F)	Licensing Basis RT_{PTS}
Intermediate Shell Forging	49D963-1-1/ 49C904-1-1		0.03	0.71	20.0	Table	-30	2.199	1.214	24.3	0	12.1	24.3	19	19
Lower Shell Forging	50D102-1-1/ 50C97-1-1		0.056	0.767	34.60	Table	-30	2.199	1.214	42.0	0	17.0	34.0	46	49
Middle Girth Weld WF-562	442011	8061	0.03	0.67	41.0	Table	40	2.199	1.214	49.8	0	24.9	49.8	140	
Credible Surveillance Data					17.0	Surv. Cap	40	2.199	1.214	20.6	0	10.3	20.6	81	81
Nozzle Shell Forging (2)	5P-7056		0.04	0.9	26.0	Table	30	0.435	0.768	20.0	0	10.0	20.0	70	
Upper Girth Weld WF-645 (2)	H4498	261	0.042	0.46	57.0	Table	-25	0.435	0.768	43.8	0	21.9	43.8	63	

12 EFPY Peak ID Surface Fluence: 8.24E+18 n/cm^2

12 EFPY Upper Girth Weld ID Surface Fluence: 1.63E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	1/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	1/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging	49D963-1-1/ 49C904-1-1		0.03	0.71	20.0	Table	-30	0.495	0.804	16.1	0	8.0	16.1	2	2
Lower Shell Forging	50D102-1-1/ 50C97-1-1		0.056	0.767	34.6	Table	-30	0.495	0.804	27.8	0	13.9	27.8	26	30
Middle Girth Weld WF-562	442011	8061	0.03	0.67	17.0	Surv. Cap	40	0.495	0.804	13.7	0	6.8	13.7	67	67
Nozzle Shell Forging (2)	5P-7016		0.04	0.71	26.0	Table	30	0.098	0.413	10.7	0	5.4	10.7	51	51
Upper Girth Weld WF-645 (2)	H4498	261	0.042	0.46	57.0	Table	-25	0.098	0.413	23.5	0	11.8	23.5	22	22

Braidwood Station Unit 2: Table 1

12 EFPY Peak ID Surface Fluence: 8.24E+18 n/cm^2

12 EFPY Upper Girth Weld ID Surface Fluence: 1.63E+18 n/cm^2 (1)

RPV Component	Heat No	Flux Lot	Best Estimate Cu (3)	Best Estimate Ni (3)	CF	CF Method	Initial RT_{NDT} (°F)	3/4T Fluence at 12 EFPY (x 10^{19})	FF	ΔRT_{NDT} (°F)	σ_I	σ_Δ	Margin (°F)	3/4T ART at 12 EFPY (°F)	Licensing Basis
Intermediate Shell Forging	49D963-1-1/ 49C904-1-1		0.03	0.71	20.0	Table	-30	0.178	0.542	10.8	0	5.4	10.8	-8	-8
Lower Shell Forging	50D102-1-1/ 50C97-1-1		0.056	0.767	34.6	Table	-30	0.178	0.542	18.8	0	9.4	18.8	8	10
Middle Girth Weld WF-562	442011	8061	0.03	0.67	17.0	Surv. Cap	40	0.178	0.542	9.2	0	4.6	9.2	58	58
Nozzle Shell Forging (2)	5P-7016		0.04	0.71	26.0	Table	30	0.035	0.241	6.3	0	3.1	6.3	43	43
Upper Girth Weld WF-645 (2)	H4498	261	0.042	0.46	57.0	Table	-25	0.035	0.241	13.8	0	6.9	13.8	2.5	2.4

References: "Braidwood Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14970, "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-232/CCE-97-315.

(1) From Westinghouse Letter CAE-97-231/CCE-97-314 and WCAP-14228: 32 EFPY Fluence extrapolated from the 12 EFPY fluence of 1.63 x 10^{18} n/cm^2. This is the top of active fuel fluence which is conservative for evaluating the weld and base metal above it.

(2) Best estimate chemistry data from Westinghouse Letter CAE-97-231/CCE-97-314.

(3) Best Estimate chemistries were determined by the mean of the sources approach where multiple sources exist, and mean for single sources.

Braidwood Station Unit 2: Table 2

Lower Shell Forging 50D102-1-1/50C97-1-1, Single Source:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BR-2	U (LT)	0.056	0.767	(1)	0.3933	0	Y
BR-2	U (TL)	0.056	0.767	(1)	0.3933	5	Y
BR-2	X (LT)	0.056	0.767	(1)	1.126	3	Y
BR-2	X (TL)	0.056	0.767	(1)	1.126	35	Y

(1) Surveillance data are from the vessel being assessed.

Middle Girth Weld WF-562, Heat # 442011, Multiple Sources:

Source	Capsule ID	Cu	Ni	Irradiation Temp (°F)	Fluence ($x10^{19}$ n/cm^2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
BR-1	U	0.032	0.671	(1)	0.3814	10	Y
BR-1	X	0.032	0.671	(1)	1.144	25	Y
BR-2	U	0.033	0.708	(1)	0.3933	0	Y
BR-2	X	0.033	0.708	(1)	1.126	20	Y

(1) Irradiation temperatures for Braidwood Units 1 & 2 surveillance data were identical.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316.

Braidwood Station Unit 2: Table 3

Lower Shell Forging 50D102-1-1/50C97-1-1, Single Source Credibility Determination:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Irradiation Temp (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	(Measured - Predicted) ΔRT_{NDT} (°F)	FF x Measured ΔRT_{NDT}	FF^2
BR-2	U	0.056	0.767	34.6	(1)	0.741	0	9.9	-9.9	0.00	0.55
BR-2	U	0.056	0.767	34.6	(1)	0.741	5	9.9	-4.9	3.71	0.55
BR-2	X	0.056	0.767	34.6	(1)	1.033	3	13.7	-10.7	3.10	1.07
BR-2	X	0.056	0.767	34.6	(1)	1.033	35	13.7	21.3	36.16	1.07
									Sum:	42.97	3.23
									Surveillance Chemistry Factor:	13.3	

(1) Surveillance data are from this vessel. No adjustment for irradiation temperature.

Credibility Criteria of 17 °F in Reg. Guide 1.99 Rev. 2 for base metal is exceeded, therefore the surveillance data is not credible.

Lower Shell Forging 50D102-1-1/50C97-1-1 Assess Chemistry Factor for Conservatism:

Surveillance Program Source	Capsule ID	Cu	Ni	Chem. Factor	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} (°F)	Measured - Predicted ΔRT_{NDT} (°F) (2)
BR-2	U	0.056	0.767	34.6	0.741	0	25.7	-25.7
BR-2	U	0.056	0.767	34.6	0.741	5	25.7	-20.7
BR-2	X	0.056	0.767	34.6	1.033	3	35.7	-32.7
BR-2	X	0.056	0.767	34.6	1.033	35	35.7	-0.7

Reg. Guide 1.99 Rev. 2, Table chemistry factor is considered conservative because these differences are less than +/- 34°F.

Reference: "Byron Unit 1 Heatup and Cooldown Limit Curves for Normal Operation and Surveillance Weld Metal Integration for Byron & Braidwood," WCAP-14824, Revision 2, with Errata in Westinghouse Letters CAE-97-220/CCE-97-304, CAE-97-231/CCE-97-314 and CAE-97-233/CCE-97-316. "Braidwood Unit 2 Heatup and Cooldown Limit Curves for Normal Operation," WCAP-14970.

See Braidwood Unit 1 Table 3 for Middle Girth Weld WF-562, Heat # 442011 Credibility Determination and Vessel Weld Chemistry Factor: