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10 CFR 50, Appendix G

August 30, 2002
BW020086

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

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

Subject: Braidwood Station Response to U. S. NRC Request for Additional
Information Regarding the Braidwood Station Pressure-Temperature Limits
Reports

Reference: Letter from J. D. von Suskil (Exelon Generation Company, LLC) to U.S.
NRC, "Pressure and Temperature Limits Report (PTLR), Braidwood Station
Unit 1 and Unit 2 ," dated June 6, 2001

In a January 23, 2002 teleconference between representatives of the NRC and Exelon Nuclear, NRC Staff requested additional information regarding the Braidwood Station Pressure-Temperature Limits Reports (PTLR). The Braidwood Station Unit 1 and Unit 2 PTLRs were revised and submitted to the NRC in the referenced transmittal. The responses to the four NRC issues are contained in Attachment 1 to this letter. Attachments 2 and 3 contain information in support of the responses.


The current Braidwood Station Unit 1 and Unit 2 PTLRs are effective for 14 Effective Full Power Years (EFPY). As of August 1, 2002, Unit 1 is at 11.318 EFPY and Unit 2 is at 11.529 EFPY. Braidwood Station is currently revising the Unit 1 and Unit 2 PTLRs to address the issues identified by the NRC. Since these changes do not involve a change in PTLR methodology, the revised PTLR will be submitted in accordance with the reporting requirements of Braidwood Station Technical Specification 5.6.6.c. Braidwood Station expects to submit the revised PTLRs before the end of September 2002.

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Please direct any questions you may have regarding this matter to Ms. Amy Ferko,
Regulatory Assurance Manager, at (815) 417-2699.

Respectfully,


James D. von Suskil
Site Vice President
Braidwood Station

Attachments: 1. Braidwood Station response to a Request for Additional Information Regarding the
Braidwood Station Pressure – Temperature Limits Reports (PTLRs)
2. Excerpt from Westinghouse Letter LTR-EMT-01-28
3. Braidwood Station Unit 1 PTLR Data Point Comparisons

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Braidwood Station

Attachment 1

**Braidwood Station Response to a Request for Additional Information
Regarding the Braidwood Station Pressure-Temperature Limits Reports (PTLRs)**

Attachment 1

Braidwood Station Response to a Request for Additional Information Regarding the Braidwood Station Pressure-Temperature Limits Reports (PTLRs)

NRC Issue #1

For the Braidwood Station Unit 1 PTLR, the values of the Chemistry Factors (CF) for both the forgings and welds listed in Table 4.1 on page 14, do not agree with those used in Table 4.4 on page 17, to calculate the Adjusted Reference Temperature (ART) values for $\frac{1}{4} T$ and $\frac{3}{4} T$ locations. For example, if the CF value listed in Table 4.1 were used in the Table 4.4 calculation, the 14 EFPY ART at the $\frac{3}{4} T$ location would be 68°F rather than 65.4°F, i.e. less conservative.

Braidwood Response to Issue #1

The values of the Chemistry Factor (CF) listed in the Braidwood Station Unit 1 PTLR, Table 4.1¹, are those calculated using all available Braidwood Station reactor vessel surveillance capsule data including the most recent Unit 1 and Unit 2 capsule data (i.e., Capsule W). These values are listed in the PTLR to document the latest surveillance capsule information. However, the Capsule W surveillance data were not used in calculating the Adjusted Reference Temperature (ART) values that were used to generate the Unit 1 heatup-cooldown curves.

The CF and ART resulting from the Unit 1 and Unit 2 Capsule W Surveillance capsules were not used as inputs to the curves since operating margin could be maintained with the existing curves, by reducing the fluence from a 16 effective full power years (EFPY) value to a 14 EFPY value to include the power uprate flux. The Braidwood Station Unit 1 PTLR Table 4.4², although not based on chemistry factors from Capsule W data, presents the ARTs using the power uprated fluence projected to 14 EFPY.

During a January 23, 2002 teleconference between representatives of the NRC and Exelon Generation Company, LLC (Exelon), the NRC staff requested clarification as to how curves based on the newer Unit 1 Capsule W chemistry results could be less conservative than the existing curves based on Unit 1 Capsule X results. The heatup and cooldown curves, based on Capsule W data, were determined to be less conservative than the existing curves because the approved calculation methodology has changed since the existing curves were generated. The Capsule W curves were based on a thermal stress intensity factor calculated from the 1995 Edition, with 1996 Addenda, of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Appendix G, "Fracture Toughness Criteria for Protection Against Failure," while the current Braidwood Station Unit 1 PTLR used a more conservative correlation for this factor from the 1989 Edition of the ASME B&PV Code, Section XI, Appendix G. The following table provides a comparison of the Braidwood Unit 1 current curves of record³ and the Braidwood Unit 1 evaluation of Capsule W data for 14 EFPY (i.e., the "reevaluated curves").

¹ "Braidwood Unit 1 Calculation of Chemistry Factors Using Surveillance Capsule Data"

² "Braidwood Unit 1 Calculation of Adjusted Reference Temperatures (ARTs) at 14 EFPY at the Limiting Reactor Vessel Material Weld Metal (Based on Surveillance Capsule Data)"

³ Submitted in Letter from J. D. von Suskil (Exelon Generation Company, LLC) to U.S.

NRC, "Pressure and Temperature Limits Report (PTLR), Braidwood Station Unit 1 and Unit 2," dated June 6, 2001.

Attachment 1

Braidwood Station Response to a Request for Additional Information Regarding the Braidwood Station Pressure-Temperature Limits Reports (PTLRs)

Braidwood Unit 1 PTLR Curve Comparison Data

Document	Flaw Location	Fluence	Fluence Factor (FF)	Chemistry Factor (CF)	Adjusted Reference Temperature (ART)	Appendix G Methodology	P-T Limits
Braidwood Unit 1 PTLR	¼ T	6.73 E18	0.889	20.6	76.6 °	ASME Section XI, Appx. G, 1989 Edition	Attachment 3, "Current PTLR Values" column
	¾ T	2.43 E18	0.616	20.6	65.4 °		
Braidwood Unit 1 Evaluation of Capsule W Data for 14 EFPY	¼ T	5.28 E18**	0.821	25.7	82 °	ASME Section XI, Appx. G, 1995 Edition w/ 1996 Addenda*	Attachment 3 "Reevaluated 14 EFPY Values" column
	¾ T	1.98 E18**	0.558	25.7	69 °		

(*) This approved methodology allows the thermal stress intensity factors to be calculated from the through wall stress distribution

(**) Fluence estimates decreased due to updated plant specific surveillance capsule dosimetry data and a reduction in the projection period from 16 EFPY to 14 EFPY.

The use of the 1995 Edition with the 1996 Addenda, Appendix G, methodology and the lower stress intensity factor correlation was approved for Braidwood Station by a 10 CFR 50.60 exemption.⁴

The current PTLR did not apply the lower stress intensity factor correlation but rather used the more conservative stress intensity factor correlation derived from Figure G-2214-1, in the 1989 Edition of ASME Section XI, Appendix G. For the current Braidwood Station Unit 1 PTLR, the only portion of the 1995 Edition with 1996 Addenda that was used in the calculation of the heatup-cooldown curves was that which was approved in ASME Code Case N-514, "Low Temperature Overpressure Protection," on July 13, 1995. The Braidwood Station Unit 1 PTLR will be revised to clarify the use of the 1995 Edition with 1996 Addenda of ASME Section XI, Appendix G.

Attachment 2 contains the Braidwood Station Unit 1 heatup-cooldown data points based on the Unit 1 Capsule W chemistry results with updated neutron fluence out to 14 EFPY. These curves were generated using the ¼ T limiting ART of 82°F and the ¾ T limiting ART of 69°F for 14 EFPY. Attachment 3 compares these data points with those in the existing Braidwood Unit 1 PTLR and demonstrates that the existing curves are more conservative.

⁴ Letter from G. F. Dick, Jr. (U. S. NRC) to O. D. Kingsley (Commonwealth Edison Company), "Exemption from Requirements of 10 CFR 50.60 - Byron, Units 1 and 2, and Braidwood, Units 1 and 2 (TAC NOS. M98344, M98345, M98346, M98347)," dated January 16, 1998.

Attachment 1

Braidwood Station Response to a Request for Additional Information Regarding the Braidwood Station Pressure-Temperature Limits Reports (PTLRs)

NRC Issue #2

For the Braidwood Station Unit 1 PTLR, the value of the CF for weld WF-645 is listed as 54°F in Table 4.2 on page 15. In Table 4.5 on page 18, the CF for this same material is listed as 46.0°F.

Braidwood Response to Issue #2

The CF for this material, i.e., the nozzle shell to intermediate shell circumferential weld seam WF-645, is 54°F. What is listed as the CF for this weld in Table 4.5⁵ and also in Table 4.6⁶ is incorrect. In addition, because of this CF error, the values for ΔRT_{PTS} , Margin, $RT_{NDT(U)}$, and RT_{PTS} in Tables 4.5 and 4.6 for WF-645 are also incorrect. The values in these Tables will be corrected in a revised Braidwood Station Unit 1 PTLR. These changes are not significant since the limiting material for Pressurized Thermal Shock (PTS) considerations is still the intermediate to lower shell circumferential weld (i.e., using surveillance capsule data) with a RT_{PTS} of 99°F, well below the PTS screening criterion of 300°F.

NRC Issue #3

For Braidwood Unit 2, the CF formula listed in the middle of Table 4.1 on page 14 has the sum of the fluence factor squared (FF^2) as 6.218. The sum of FF^2 listed in the column is 6.328. Which is correct? Does this affect the CF value?

Braidwood Response to Issue #3

This is a typographical error. The value of 6.218 listed in the formula expression is incorrect; it should be 6.328. However, the actual CF calculation uses the correct value of 6.328. Therefore, the final CF value of 12.9°F is correct. This will be corrected in a revised Braidwood Station Unit 2 PTLR.

NRC Issue #4

In the Braidwood Unit 2 PTLR, the FF (fluence factor) value in Table 4.1 on page 14 for Capsule X from Unit 1 is listed as 1.060 and the FF^2 value listed for this capsule is listed as 1.266. 1.060 squared is 1.124. What value is correct?

Braidwood Response to Issue #4

This is also a typographical error. The FF^2 listing of 1.266 is incorrect. The correct FF value for Braidwood Unit 1, Capsule X is 1.060. The correct FF^2 value is 1.124. The summation of the FF^2 values uses the correct value of 1.124. Therefore, the CF calculation that uses the FF^2 summation is correct. This will be corrected in a revised Braidwood Station Unit 2 PTLR.

⁵ " RT_{PTS} Calculation for Braidwood Unit 1 Beltline Region Materials at EOL (32 EFPY)", where RT_{PTS} is the estimated reference temperature nil-ductility transition temperature using end-of-life (EOL) neutron fluence values.

⁶ " RT_{PTS} Calculation for Braidwood Unit 1 Beltline Region Materials at Life Extension (48 EFPY)".

Attachment 2

Excerpt from Westinghouse Letter LTR-EMT-01-28

Providing Braidwood Station Unit 1 14 EFPY Heatup / Cooldown Datapoints



LTR-EMT-01-28

From: Engineering & Materials Technology
WIN: 284-3898
Date: February 5, 2001
Subject: Transmittal of Braidwood Unit 1 PT Curves and Braidwood Unit 2 Draft PT Curve WCAP

To: T. J. Gerlowski EC/East/480C

cc: D. M. Trombola EC/East/3-02* C. H. Boyd EC/East/5-01*
C. S. Hauser EC/East/509* R. J. Morrison EC/East/416C*
S. J. Srinivasan EC/East/362A

Per our discussions with Exelon it was agreed that Westinghouse would provide a new applicability date for the Braidwood Unit 1 16 EFPY Pressure Temperature (PT) Curves that were issued under WCAP-14243, along with new PT Curves that justify the new date. In addition, Westinghouse was to supply a PT Curve WCAP for new curves generated for Braidwood Unit 2.

Attachment 1 contains 12 and 14 EFPY PT curves and data points for Braidwood Unit 1. By comparing the data points in Attachment 1 to the data points found in Tables 6 and 7 of WCAP-14243, it can be concluded that 16 EFPY curves in WCAP-14243 are bounding. Thus, are now acceptable for up to 14 EFPY. The PT curves in Attachment 1 were developed using the 1996 ASME Code, Section XI, Appendix G and the 5% uprated fluences.

Attachment 2 contains 10 copies of the following **Draft Report**:

WCAP-15626, *"Braidwood Unit 2 12 and 14 EFPY Heatup and Cooldown Limit Curves For Normal Operation Using Uprated Fluences"*

If you have any questions, feel free to give me a call.

Author:

J. H. Ledger,
Engineering & Materials Technology

Review By:

T.J. Laubham,
Engineering & Materials Technology

* Indicates attachments not needed.

Table 3

CCE:Braidwood Unit 1 14 EFPY Curve Points Using 1996 App. G w/Kia, w/o margins or Delta P, w/ Flange Requirement

Heatup Curves					
100 Heatup		Critical Limit		Leak Test Limit	
T	P	T	P	T	P
60	0	207	0	186	2000
60	613	207	613	207	2485
65	613	207	613		
70	613	207	616		
75	613	207	616		
80	613	207	620		
85	613	207	621		
90	613	207	621		
95	613	207	621		
100	613	207	621		
105	616	207	621		
110	620	207	621		
110	621	207	627		
110	621	207	635		
115	627	207	646		
120	635	207	659		
125	646	207	673		
130	659	207	690		
135	673	207	709		
140	690	207	730		
145	709	207	754		
150	730	207	779		
155	754	207	807		
160	779	210	838		
165	807	215	872		
170	838	220	908		
175	872	225	947		
180	908	230	990		
185	947	235	1036		
190	990	240	1086		
195	1036	245	1139		
200	1086	250	1197		
205	1139	255	1259		
210	1197	260	1326		
215	1259	265	1398		
220	1326	270	1476		

Table 3 Continued

CCE:Braidwood Unit 1 14 EFPY Curve Points Using 1996 App. G w/Kia, w/o margins or Delta P, w/ Flange Requirement

Heatup Curves					
100 Heatup		Critical Limit		Leak Test Limit	
T	P	T	P	T	P
225	1398	275	1559		
230	1476	280	1649		
235	1559	285	1745		
240	1649	290	1848		
245	1745	295	1959		
250	1848	300	2079		
255	1959	305	2207		
260	2079	310	2344		
265	2207				
270	2344				

Table 4

CCE:Braidwood Unit 1 14 EPFY Data points using 1996 App. G w/Kia, w/o margins or Delta P,
w/ Flange Requirement

Cooldown Curves							
Steady State		-25F		-50F		-100F	
T	P	T	P	T	P	T	P
60	0	60	0	60	0	60	0
60	621	60	602	60	554	60	455
65	621	65	616	65	568	65	471
70	621	70	621	70	583	70	489
75	621	75	621	75	599	75	508
80	621	80	621	80	617	80	529
85	621	85	621	85	621	85	552
90	621	90	621	90	621	90	576
95	621	95	621	95	621	95	603
100	621	100	621	100	621	100	621
105	621	105	621	105	621	105	621
110	621	110	621	110	621	110	621
110	621	110	621	110	621	110	621
110	826	110	790	110	757	110	695
115	851	115	818	115	787	115	731
120	878	120	848	120	819	120	769
125	908	125	880	125	854	125	811
130	940	130	914	130	891	130	856
135	974	135	951	135	932	135	904
140	1010	140	991	140	975	140	957
145	1050	145	1034	145	1022	145	1013
150	1092	150	1080	150	1072	150	1074
155	1137	155	1129	155	1126	155	1137
160	1186	160	1183	160	1185	160	1186
165	1239	165	1239	165	1239	165	1239
170	1295	170	1295	170	1295	170	1295
175	1356	175	1356	175	1356	175	1356
180	1422	180	1422	180	1422	180	1422
185	1492	185	1492	185	1492	185	1492
190	1567	190	1567	190	1567	190	1567
195	1649	195	1649	195	1649	195	1649
200	1736	200	1736	200	1736	200	1736
205	1830	205	1830	205	1830	205	1830
210	1931	210	1931	210	1931	210	1931
215	2039	215	2039	215	2039	215	2039
220	2156	220	2156	220	2156	220	2156
225	2281	225	2281	225	2281	225	2281
230	2416	230	2416	230	2416	230	2416

Attachment 3

Braidwood Station Unit 1

PTLR Data Point Comparisons

Attachment 3

Braidwood Station Unit 1 Heat Up Curves
PTLR Data Point Comparison

100 degree Heatup			Criticality Limit		
Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *	Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *
60	0	0	207	0	0
60	565.09	613	207	0	613
65	565.09	613	207	0	616
70	565.09	613	207	0	620
75	565.09	613	207	0	621
80	565.09	613	207	0	627
85	565.09	613	207	0	635
90	565.09	613	207	0	646
95	565.09	613	207	0	659
100	565.87	613	207	0	673
105	568.69	616	207	0	690
110	573.56	620	207	0	709
110	573.56	621	207	0	730
115	580.30	627	207	0	754
120	588.84	635	207	0	779
125	599.36	646	207	0	807
130	611.78	659	210	0	838
135	626.06	673	210	611.83	838
140	642.16	690	210	597.56	838
145	660.36	709	210	585.60	838
150	680.59	730	210	576.77	838
155	702.80	754	210	570.35	838
160	727.33	779	210	566.61	838
165	754.07	807	210	565.09	838
170	783.17	838	210	565.87	838
175	814.98	872	210	568.69	838
180	849.37	908	210	573.56	838
185	886.54	947	210	580.30	838
190	926.73	990	210	588.84	838
195	970.11	1036	210	599.36	838
200	1016.91	1086	210	611.78	838
205	1067.33	1139	210	626.07	838
210	1121.63	1197	210	642.16	838
215	1180.01	1259	210	660.36	838
220	1242.62	1326	210	680.56	838
225	1309.84	1398	210	702.80	838
230	1382.03	1476	210	727.33	838
235	1459.45	1559	210	754.07	838
240	1542.27	1649	210	783.17	838
245	1630.97	1745	215	814.98	872

* Reevaluated 14 EFPY Pressure Values using 1996 ASME Appendix G Stress Intensity Factors

Attachment 3

Braidwood Station Unit 1 Heat Up Curves
PTLR Data Point Comparison

100 degree Heatup			Criticality Limit		
Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *	Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *
250	1726.05	1848	220	849.37	908
255	1827.80	1959	225	886.54	947
260	1936.51	2079	230	926.73	990
265	2052.39	2207	235	970.11	1036
270	2176.33	2344	240	1016.91	1086
275	2308.42		245	1067.33	1139
280	2449.09		250	1121.63	1197
			255	1180.01	1259
			260	1242.62	1326
			265	1309.84	1398
			270	1382.03	1476
			275	1459.45	1559
			280	1542.27	1649
			285	1630.97	1745
			290	1726.05	1848
			295	1827.80	1959
			300	1936.51	2079
			305	2052.39	2207
			310	2176.33	2344
			315	2308.42	
			320	2449.09	
Leak Test Limit					
Temperature	Current PTLR	Reevaluated			
186		2000			
188	2000				
207		2485			
210	2485				

* Reevaluated 14 EFPY Pressure Values using 1996 ASME Appendix G Stress Intensity Factors

Attachment 3

Braidwood Station Unit 1 Cooldown Curves
PTLR Data Point Comparison

Steady State			25 Degrees per Hour Cooldown		
Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *	Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *
60	0	0	60	0	0
60	620.27	621	60	577.45	602
65	621.00	621	65	590.68	616
70	621.00	621	70	605.03	621
75	621.00	621	75	620.51	621
80	621.00	621	80	621.00	621
85	621.00	621	85	621.00	621
90	621.00	621	90	621.00	621
95	621.00	621	95	621.00	621
100	621.00	621	100	621.00	621
105	621.00	621	105	621.00	621
110	621.00	621	110	621.00	621
110	795.92	826	110	766.92	790
115	821.55	851	115	794.59	818
120	849.00	878	120	824.45	848
125	878.42	908	125	856.54	880
130	910.25	940	130	890.97	914
135	944.34	974	135	928.00	951
140	980.89	1010	140	967.79	991
145	1020.15	1050	145	1010.84	1034
150	1062.35	1092	150	1056.88	1080
155	1107.92	1137	155	1106.38	1129
160	1156.42	1186	160		1183
165	1208.78	1239	165		1239
170	1265.05	1295	170		1295
175	1325.37	1356	175		1356
180	1390.04	1422	180		1422
185	1459.41	1492	185		1492
190	1533.55	1567	190		1567
195	1613.49	1649	195		1649
200	1699.01	1736	200		1736
205	1790.55	1830	205		1830
210	1888.61	1931	210		1931
215	1993.61	2039	215		2039
220	2105.69	2156	220		2156
225	2225.77	2281	225		2281
230	2353.75	2416	230		2416

* Reevaluated 14 EFPY Pressure Values using 1996 ASME Appendix G Stress Intensity Factors

Attachment 3

Braidwood Station Unit 1 Cooldown Curves
PTLR Data Point Comparison

50 Degrees per Hour Cooldown			100 Degrees per Hour Cooldown		
Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *	Temperature	Current PTLR Pressure Values	Reevaluated 14 EFPY Pressure Values *
60	0	0	60	0	0
60	534.28	554	60	446.98	455
65	548.52	568	65	463.79	471
70	563.98	583	70	481.93	489
75	580.67	599	75	501.49	508
80	598.51	617	80	522.68	529
85	617.90	621	85	545.50	552
90	621.00	621	90	570.23	576
95	621.00	621	95	596.83	603
100	621.00	621	100	621.00	621
105	621.00	621	105	621.00	621
110	621.00	621	110	621.00	621
110	739.27	757	110	690.04	695
115	769.53	787	115	726.24	731
120	801.97	819	120	765.12	769
125	836.87	854	125	807.07	811
130	874.41	891	130	852.23	856
135	915.03	932	135	900.91	904
140	958.57	975	140	953.33	957
145	1005.42	1022	145	1009.81	1013
150	1055.76	1072	150		1074
155		1126	155		1137
160		1185	160		1186
165		1239	165		1239
170		1295	170		1295
175		1356	175		1356
180		1422	180		1422
185		1492	185		1492
190		1567	190		1567
195		1649	195		1649
200		1736	200		1736
205		1830	205		1830
210		1931	210		1931
215		2039	215		2039
220		2156	220		2156
225		2281	225		2281
230		2416	230		2416

* Reevaluated 14 EFPY Pressure Values using 1996 ASME Appendix G Stress Intensity Factors