Program Management Office
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BAW-2308-NP, Rev.2
Project Number 694

OG-07-47

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington DC 20555-0001

Subject: Pressurized Water Reactor Owners Group
Submittal of BAW-2308-NP, Revision 2 "Initial RT_{NDT} of Linde 80 Weld Materials" PA-MSC-0229

Reference 1: Letter, H. N. Berkow (NRC) to J. S. Holm (AREVA), "Final Safety Evaluation for Topical Report BAW-2308, Revision 1, 'Initial RT_{NDT} of Linde 80 Weld Materials' (TAC No. MB6636)," August 4, 2005 (ML052070408).

Reference 2: Letter, Howard Crawford (B&WOG Steering Committee) to NRC Document Control Desk, "Publication of BAW-2308(NP), Revision 1, "Initial RT_{NDT} of Linde 80 Weld Materials," November 17, 2005.

The Pressurized Water Reactor Owners Group (PWROG) is requesting formal review of BAW-2308 Revision 2 in accordance with the Nuclear Regulatory Commission (NRC) licensing topical report program for review and acceptance for referencing in licensing actions. BAW-2308 Revision 2 is applicable to the ANO 1, Crystal River 3, Davis Besse, Oconee 1-3, TMI 1, Point Beach 1-2, Surry 1-2, and Turkey Point 3-4 plants. Four paper copies of the report are being submitted with this letter.

BAW-2308 Revision 2 presents data for Linde 80 weld wire heat 61782 which was requested in the NRC safety evaluation (Reference 1) to BAW-2308, Revision 1-A (Reference 2). In addition, this report also updates all the IRT_{To} values and associated initial margin terms to account for an industry consensus approved loading rate correction which is in the process of being adopted into ASTM E1921.

Consistent with the Office of Nuclear Reactor Regulation, Office Instruction LIC-500, "Processing Request for Reviews of Topical Reports," the PWROG requests that the NRC provide target dates for any Request(s) for Additional Information and for issuance of the Safety Evaluation for BAW-2308, Revision 2.

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Correspondence related to this transmittal and invoices associated with the review of BAW-2308, Revision 2 should be addressed to:

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If you have any questions, please do not hesitate to contact me at (630) 657-3897, or if you require further information, please contact Mr. Jim Molkenthin of the PWR Owners Group Project Management Office at (860) 731-6727.

Regards,

Frederick P. "Ted" Schiffley, II, Chairman
PWR Owners Group

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Enclosures (4)

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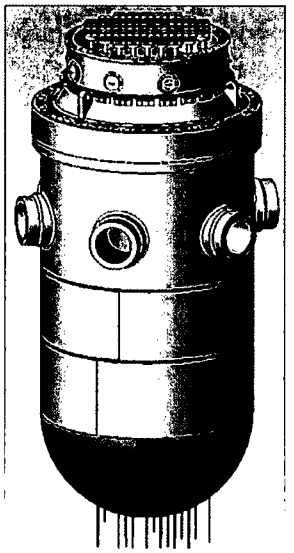
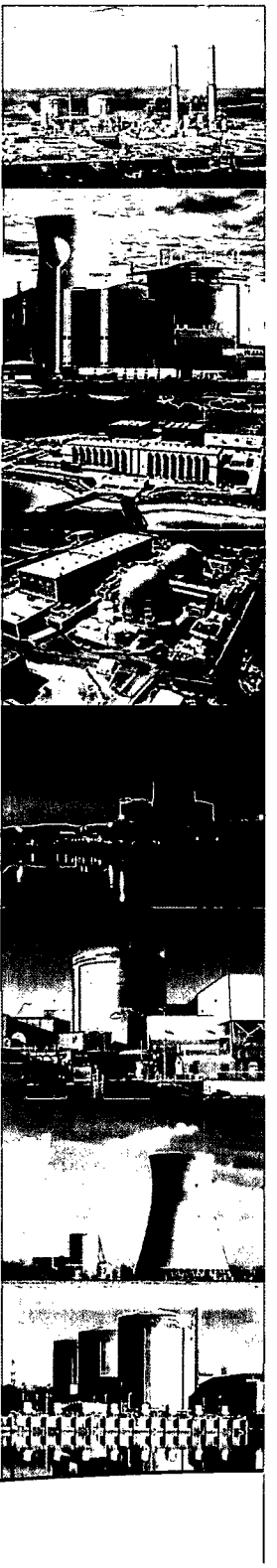
BAW-2308 Revision 2
January 2007

INITIAL RT_{NDT} OF LINDE 80 WELD MATERIALS





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PWR Owners Group

Dominion Energy
Duke Energy Corporation
Entergy Operations, Inc.
Exelon Nuclear Corporation
FirstEnergy Nuclear Operating Company
Florida Power & Light Company
Nuclear Management Company
Progress Energy

AREVA

AREVA NP Inc.

BAW-2308 Revision 2

January 2007

INITIAL RT_{NDT} OF LINDE 80 WELD MATERIALS

Prepared for

PWR Owners Group

Participating Members:
Dominion Energy
Duke Energy Corporation
Entergy Operations, Inc.
Exelon Nuclear Corporation
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Executive Summary

This is a supplement to BAW-2308, Revision 1-A which was prepared for the PWR Owners Group (PWROG) to update alternative initial reference temperatures (IRT_{To}) for the Linde 80 beltline welds in the B&W fabricated reactor vessels. The alternative IRT_{To} values were determined based on brittle-to-ductile transition range fracture toughness test data of these weld metals obtained in accordance with ASTM Standard E1921 and using ASME Boiler and Pressure Vessel Code Case N-629. This report was prepared to provide data for Linde 80 weld wire heat 61782 which was requested in the NRC safety evaluation to BAW-2308, Revision 1-A. In addition, this report also updates the IRT_{To} values and associated initial margin terms to account for a consensus approved loading rate correction which is in the process of being adopted into ASTM E1921. This additional assessment revealed that the IRT_{To} values in the safety evaluation are conservative except for two IRT_{To} values for weld wire heat 72105 and heat 299L44. A licensee who wants to utilize the methodology of BAW-2308, Revision 1-A must request an exemption, per 10CFR50.12, from the requirements of 10CFR50.61 or 10CFR50 Appendix G. A license exemption has only been requested for Surry Units 1 and 2 using the lowered IRT_{To} values in BAW-2308, Revision 1-A, therefore none of the other applicable units are currently affected. In Surry Unit 1 heat 299L44 is the limiting material in terms of margin to the PTS (10CFR50.61) screening limit, however even with this increase in IRT_{To}, there is ample margin.

Table of Contents

1. Background

BAW-2308 was prepared for the B&W Owners Group (B&WOG) Reactor Vessel Working Group (RVWG) to justify alternative initial reference temperatures (IRT_{NDT}) for the Linde 80 beltline welds in the B&W fabricated reactor vessels.[a] The alternative IRT_{NDT} was determined based on brittle-to-ductile transition range fracture toughness test data of these weld metals obtained in accordance with ASTM Standard E1921 and using ASME Boiler and Pressure Vessel Code Case N-629. This report was submitted to the NRC for review and acceptance as a B&WOG topical for application to the pressurized thermal shock (PTS) rule (10CFR50.61) and 10CFR50, Appendix G, pressure-temperature limits.

Topical report BAW-2308 was submitted to the NRC in July 2002.[1] A request for additional information (RAI) was received in April 2003. A response was sent to the NRC and BAW-2308 Revision 1 was issued in August 2003 addressing the RAI.[2] In January 2004 an additional RAI was received. This RAI reflected a concern which was raised at an ASME code meeting regarding Code Case N-629. This additional RAI was addressed in June 2004. Through various communications with the NRC, additional information was provided in early 2005. The final safety evaluation (SE) was issued in August 2005.[3] The conclusions from the SE included two actions that must be addressed:

1. The B&WOG stated in their August 19, 2003 RAI response that fracture toughness data from 1 more heat of Linde 80 weld material (weld wire heat 61782) is to be obtained. The NRC staff expects B&WOG to evaluate this data to determine whether or not the conclusions of topical report BAW-2308 Rev. 1 and this SE are non-conservative and to communicate B&WOG's conclusion to the NRC staff. Non-conservatism in the BAW-2308 Rev. 1 report would be evident if 1) the IRT_{To} value from the to be tested Linde 80 weld wire heat turns out to be higher than the generic IRT_{To} value approved in this SE or 2) if the data from the to be tested Linde 80 weld wire heat results in an increase in the Linde 80 generic σ_I value.
2. Although the staff concludes that there is reasonable assurance that the use of IRT_{To} values for Linde 80 weld materials which were determined using the loading rate correction addressed in BAW-2308 rev 1 is acceptable for the purpose of reactor pressure vessel material property determination, the staff expects that action will be pursued within the appropriate consensus codes and standards organizations to address

[a] B&WOG merged with the Westinghouse Owners Group at the end of 2005 forming the PWROG. This report was prepared under funding from the PWROG.

> loading rate effects on a more generic basis (or determine that they do not need to be addressed) in the appropriate ASME Code Cases and/or ASTM Standard Test Methods. The staff requests that the B&WOG revise the recommended values in BAW-2308, Revision 1 in accordance with Table 3. When consensus codes and standards organizations address loading rate effects on a more generic basis, the staff also expects that the B&WOG will re-evaluate BAW-2308, Revision 1 to determine whether or not revision of the topical report is warranted.[3]

An approved version of the topical report[4] was issued in 2005.[5] Virginia Electric and Power Company has requested an exemption from the requirements of 10CFR50.61 and 10CFR50 Appendix G to revise Surry 1 and 2 initial RT_{NDT} values using BAW-2308, Revision 1-A.[6] Nuclear Management Company, Exelon, FirstEnergy Nuclear Operating Company, and Florida Power and Light intend in the future to submit license exemption requests from 10CFR50.61 or 10CFR50 Appendix G for Point Beach Units 1 and 2, Three Mile Island Unit 1, Davis-Besse, and Turkey Point Units 3 and 4, respectively.

2. Test Results from Linde 80 Weld Wire Heat 61782

B&WOG Master Integrated Reactor Vessel Surveillance Program (MIRVP) capsule DB1-LG2 was irradiated in Davis-Besse from cycle 2 through cycle 11. This capsule contained specimens fabricated from weld wire heat 61782. Baseline and irradiated specimen testing was conducted and reported in the DB1-LG2 capsule report.[7] The capsule report was provided to the NRC for information in 2005.[8] This data was not available when BAW-2308 was written and was not included in the BAW-2308 analysis at the time.

The SA-1135 (wire heat 61782 and flux lot 8457) baseline specimens used to measure the transition temperature fracture toughness consisted of three 0.500 TC(T) and four 0.936 DC(T) specimens tested in compliance with the requirements of ASTM Standard E 1921-02. The test results are shown in Table 1. Two 0.394 TC(T), four 0.500 TC(T), and two 0.936 TDC(T) specimens also from SA-1135 with an average fluence of 1.368×10^{19} n/cm^2 (E > 1 MeV) were also tested per ASTM E1921-02. See Table 2 for the irradiated specimen test results.

Table 1. Baseline Fracture Toughness Data for Weld Metal SA-1135 (Oconee-2 nozzle drop-out; Wire Heat 61782)

Specimen Identification	Specimen Geometry	Test Temperature (°F)	J_c (in-lb/in^2)	K_{Jc} (ksi$\sqrt{in}$)	Violations
PW048	0.936 DC(T) [(a)]	-80	444	115.2	
PW049	0.936 DC(T)	-80	373	105.6	
PW050	0.936 DC(T)	-80	429	113.2	
PW051	0.936 DC(T)	-80	488	120.8	
PW021	0.5 TC(T) [(b)]	-110	397	109.2	
PW024	0.5 TC(T)	-110	459	117.4	
PW030	0.5 TC(T)	-110	190	75.5	

(a) Disk shaped compact fracture specimen.
(b) Compact fracture specimen.

Table 2. Fracture Toughness Data for Weld Metal SA-1135 (Wire Heat 61782) Irradiated to an Average Fluence of 1.368×10^{19} n/cm^2 (E > 1 MeV) in the DB1-LG2 Capsule

Specimen Identification	Specimen Geometry	Test Temperature (°F)	J_c (in-lb/in^2)	K_{Jc} (ksi$\sqrt{in}$)	Violations
PW008	0.394TC(T)	45	455	115.4	
PW006	0.394TC(T)	45	499	120.8	
PW028	0.5TC(T)	70	221	80.2	
PW027	0.5TC(T)	70	468	116.8	
PW020	0.5TC(T)	70	524	123.5	
PW026	0.5TC(T)	70	644	137.0	
PW045	0.936DC(T)	32	90.4	51.5	
PW040	0.936DC(T)	70	155	67.2	
PW041	0.936DC(T)	100	360	102.1	

The multi-temperature method (ASTM Standard E1921-05) of calculating the reference temperate was used to calculate the reference temperatures. Both data sets yielded valid T_0's as defined by ASTM Standard E 1921-05 as shown in Table 3. All validity criteria were met as specified in ASTM Standard E1921-05. No crack growth was observed on any of the fracture toughness test specimens. The optical crack length measurements were consistent with those determined from the compliance method. The rate adjusted T_0 values are adjusted to a loading rate of 1 MPa$\sqrt{m}$/sec as described in BAW-2308:

$$T_0|_{R2} = T_0|_{R1} + 5.33\,\ell n(R2/R1)$$

where: R1 and R2 are loading rates in units of and T_0 is in °C.

Table 3. Master Curve Reference Temperature (T_0) Data for Linde 80 Weld Wire Heat 61782

Weld	Average Fluence x 10^{19} n/cm^2 (E > 1 MeV)	Specimen Type	Number of Uncensored Specimens/ Minimum Required	T_0 (°F)	dK/dt (MPa $\sqrt{m}$/s)	Rate Adjusted T_0 (°F)	E1921-05 Validity
SA-1135 (Oconee-2 nozzle drop-out)	0.000	0.5TC(T) and 0.936DC(T)	7/6	-99.0	0.38	-89.8	Valid
SA-1135 (Oconee-2 nozzle drop-out) Irradiated in the DB1-LG2 Capsule	1.368	0.394TC(T), 0.5TC(T) and 0.936DC(T)	9/6	65.5	0.38	74.6	Valid

The IRT_{To} value for 61782 and the margin term are discussed below after considering the ASTM E1921 proposed loading rate effect.

3. Loading Rate Effect

BAW-2308 Revision 0 used rate adjusted T_0 values and margins to account for the various test loading rates (dK/dt) per an AREVA developed correlation.[9] BAW-2308 Revision 1 included T_0 and margin values that did not include any loading rate adjustment, since a rate adjustment had not been included in the consensus ASTM E1921 standard at the time. However, the unadjusted values turned out to be less conservative (lower T_0), in most cases, than the rate adjusted values reported in BAW-2308, Revision 0. Therefore the NRC accepted the use of the rate adjusted T_0 and margin values in the final safety evaluation. The NRC requested that the loading rate issue be reexamined when the loading rate effect was addressed in ASTM E1921.

The allowed quasi-static loading rate range in the E1921-97 and -02 versions was defined as the time to reach P_M which was restricted to 0.1-10 minutes. P_M is defined as 40% of the limit load, where the limit load is a function of the specimen size, geometry and the material yield strength. All the test data used in BAW-2308 is within the allowed loading rate range of E1921-97 and E1921-02. The ASTM E08 committee recognized that there is an effect of loading rate within the loading rate range defined in E1921-02, so they responded by reducing and redefining the allowable loading rate in the E1921-05 version. In E1921-05 the loading rate is limited to a dK/dt of 0.1 to 2 MPa$\sqrt{m}$/s during the elastic portion of specimen loading. In BAW-2308 the loading rate was reported as dK/dt, the same as defined in E1921-05. These dK/dt values are reported for each group of tests as an average value. The dK/dt of the various unirradiated Linde 80 data sets used to establish the RT_{To} values in BAW-2308, Revision 0 are listed in Table 4. Five groups of data exceed the E1921-05 loading rate restriction by a relatively small amount.

Table 4 Unirradiated Linde 80 Data Set Loading Rates

Weld-Wire	Weld Id	Specimen Type	dK/dt (MPa√m/s)
71249	SA-1094	PCS	0.22
72105	WF-70(B)	RPCS	0.22
72442	WF-67	Various CT	0.22
72442	WF-67	PCS	0.22
72445	SA-1585	PCS	0.22
299L44	WF-25	PCS	0.22
406L44	WF-112	PCS	0.22
406L44	WF-193	0.5TCT	0.22
406L44	WF-193	RPCS/PCS	0.22
821T44	WF-182-1	PCS	0.22
821T44	WF-182-1	0.5TCT	0.22
61782	SA-1135	Various CT	0.38
72442	SA-1484	PCS	1.21
299L44	WF-25 64W	PCCS	1.87
72105	WF-70(B)	1TCT	1.40
72105	WF-70(B)	1TCT	1.50
72105	WF-70(B) ORNL	Various	1.87
72105	WF-70(N) ORNL	Various	1.87
72445	SA-1585 65W	PCCS	1.87
299L44	WF-25 63W	PCCS	1.87
299L44	WF-25	0.5TCT	2.20
406L44	WF-193	0.5TCT	2.26
821T44	WF-182-1	0.5TCT	2.27
406L44	WF-112	0.5TCT	2.29
299L44	SA-1526	0.5TCT	2.35

The ASTM E08.08 committee is in the process balloting a change to E1921 which includes a method to adjust T_0 due to the loading rate effect. The loading rate adjustment is based on a paper written by K. Wallin:[10]

$$T_0 = \frac{T_{01} \cdot \Gamma}{\Gamma - \ln(\dot{K}_I)}$$

or for the loading rate induced temperature shift:

$$\Delta T_0 = \frac{T_{01} \cdot \ln(\dot{K}_I)}{\Gamma - \ln(\dot{K}_I)}$$

where:

$$\Gamma = 9.9 \cdot \exp\left\{\left(\frac{T_{01}}{190}\right)^{1.66} + \left(\frac{\sigma_{YS}}{722}\right)^{1.09}\right\}$$

and where:

T_{01} refers to the quasi-static loading rate of $dK/dt = \dot{K}_I = 1$ MPa$\sqrt{m}$/s,

T_0 and T_{01} are in degrees Kelvin and σ_{YS} is in MPa.

Using the above equations to adjust the loading rates of the five data sets that were tested faster than 2 MPa$\sqrt{m}$/s to the limit of 2 MPa$\sqrt{m}$/s, results in a reduction of 0.9°F in T_0. This model predicts a loading rate effect of 13.3°F on T_0 from the slowest to the fastest loading rate extremes shown in Table 5, while the AREVA model predicts an effect of 22.9°F. The proposed E1921 loading rate model predicts a lower loading rate effect on T_0 than the AREVA model for the Linde 80 welds.

T_0 was calculated for each heat using the new loading rate equation being considered for E1921 (The precracked Charpy size (PCCS) bias used in BAW-2308 was also included). The results are tabulated in Table 5 along with the values reported in BAW-2308, Revision 1 for comparison.

Table 5 Multi-Temperature T_0 Calculation Results
(Italicized values are from BAW-2308, Revision 1 Table 4-4)

Heat	Adjusted T_0[a] (°F)		
	Without Rate Adjustment	BAW-2308 Rate Adjustment[c]	Proposed E1921 Rate Adjustment
406L44	*-138.6*	*-129.9*	-133.0
71249	*-97.0*	*-82.4*	-88.5
72105	*-64.1*	*-67.7*	-66.1
821T44	*-125.8*	*-115.2*	-119.2
299L44	*-113.8*	*-116.8*	---
299L44 with 8 added tests from TMI2-LG2	-107.7	---	-109.3
72442	*-72.8*	*-65.0*	-68.2
72445	*-108.2*	*-107.5*	-107.5
61782	-99.0	-89.8	-93.5
All 7 Linde 80 Heats[b]	***-110.5***	***-102.6***	**---**
All 8 Linde 80 Heats with 61782 and new 299L44 data[b]	**-109.4**	**---**	**-103.6**

a Adjustment includes PCCS bias correction as appropriate.

b All the data were combined for single multi-temperature calculation.

c Basis for IRT_{To} values approved in the SE (except 61782).

Eight additional baseline transition temperature tests were conducted on heat 299L44 as part of the TMI2-LG2 capsule testing in 2003 and are reported in the corresponding surveillance capsule report.[11] This data has been added to the 299L44 multi-temperature T_0 calculation with the results shown in Table 5. The resulting T_0 value with the new data and the new loading rate adjustment is 7.5°F higher than the 299L44 dataset considered in BAW-2308, Revision 0 and Revision 1.

4. Uncertainty Evaluation

Monte Carlo analyses were performed using the same procedure described in BAW-2308 using PCCS bias and the proposed E1921 loading rate adjusted data. The new data for the 299L44 heat was included. Analysis was also performed for the entire Linde 80 dataset combined

including the new 299L44 data and the 61782 data. The results are reported in Table 6 along with the results from BAW-2308 Revision 1 for comparison.

There were 7 tests conducted to determine the initial T_0 for heat 61782. There is insufficient data to properly perform a Monte Carlo analysis since a minimum of 6 tests are required to calculate T_0. In addition, all the material was from one source and a Monte Carlo analysis would not properly reflect the material variability. Therefore, an estimate of σ_I is determined by using the average standard deviation from the other individual Linde 80 heats (See Table 6).

Table 6 Summary of Monte Carlo Analysis Results
(Italicized values are from BAW-2308, Revision 1 Table 4-5)

Heat	Adjusted Standard Deviation[a] (°F)		
	Without Rate Adjustment	BAW-2308 Rate Adjustment[b]	Proposed E1921 Rate Adjustment
406L44	*10.9*	*9.7*	10.4
71249	*7.3*	*7.2*	7.1
72105	*13.0*	*12.9*	13.4
821T44	*7.5*	*6.5*	7.0
299L44	*9.8*	*9.3*	---
299L44 with 8 added tests from TMI2-LG2	---	---	11.3
72442	*9.3*	*9.3*	9.7
72445	*6.7*	*7.5*	6.9
61782	---	---	9.4[c]
All 7 Linde 80 Heats	*20.0*	*17.1*	---
All 8 Linde 80 Heats with 61782 and new 299L44 data	---	---	17.9

a Adjustment includes PCCS bias correction as appropriate.

b Basis for IRT_{To} values approved in the SE.

c Average of the 7 other heat standard deviations with the proposed E1921 rate adjustment.

The sample size uncertainty is calculated using the same procedure as in BAW-2308, Revision 1. The results are reported in Table 7 with the data from BAW-2308, Revision 1 included.

Table 7 Sample Size Uncertainty
(Italicized values are from BAW-2308, Revision 1 Table 4-6)

Heat	Number of Uncensored Specimens	1T $K_{Jc(med)}$ (MPa$\sqrt{m}$)	β	σ (°F)
406L44	*39*	*103*	*18.0*	*5.2*
71249	*10*	*71*	*18.8*	*10.7*
72105	*121*	*105*	*18.0*	*2.9*
821T44	*24*	*102*	*18.0*	*6.6*
299L44	*22*	*107*	*18.0*	*6.9*
299L44 with 8 added tests from TMI2-LG2	29	103	18.0	6.0
72442	*21*	*82*	*18.8*	*7.4*
72445	*12*	*77*	*18.8*	*9.8*
61782	7	112	18.0	12.2
All 7 Linde 80 Heats	*249*	*95*	*18.0*	*2.1*
All 8 Linde 80 Heats with 61782 and new 299L44 data	263	96	18.0	2.0

The Monte Carlo standard deviation is combined with the sample size uncertainty using the square root of the sum of the squares in the same manner that was done in BAW-2308. The σ_I values are shown in Table 8 as well as the values from BAW-2308 for comparison.

Table 8 Summary of σ_I Values
(Italicized values are from BAW-2308, Revision 0 Table 4-7 or BAW-2308, Revision 1 Table 4-7)

Heat	σ_I Values (°F)		
	PCCS Adjusted	PCCS + BAW-2308 Rate Adj.[a]	PCCS + proposed E1921 Rate Adj.
406L44	*12.1*	*11.0*	11.6
71249	*13.0*	*12.9*	12.8
72105	*13.3*	13.2[b]	13.7
821T44	*10.0*	*9.3*	9.6
299L44	*12.0*	*11.6*	---
299L44 with 8 added tests from TMI2-LG2	---	---	12.8
72442	*11.9*	*11.9*	12.2
72445	*11.9*	*12.3*	12.0
61782	---	---	15.4
All 7 Linde 80 Heats[a]	*20.1*	*17.2*	---
All 8 Linde 80 Heats with 61782 and new 299L44 data[a]	---	---	18.0

[a] Basis for IRT_{To} values approved in the SE.

[b] 11.8F was used in the SE, which was based on an incomplete dataset from BAW-2308, Revision 0.

5. Conclusions

The RT_{To} for each heat and all heats combined using the new loading rate equation being considered for ASTM E1921 and the new data described herein are tabulated in Table 9 along with the values approved in the SE for comparison. When combining the σ_I values in Table 9 and $\sigma_\Delta = 28°F$ with IRT_{To}, the values from the SE are conservative relative to the IRT_{To} and σ_I values presented in this revision, with the exception of heats 72105 and 299L44. Heat 72105 is non-conservative relative to the SE by 3.2°F and heat 299L44 is non-conservative relative to the SE by 8.5°F. In the Surry 1 license exemption request, heat 299L44 is the limiting material in terms of margin to the PTS (10CFR50.61) screening limit, however even with this increase in IRT_{To}, there is ample margin.[6]

Table 9. Heat Specific and Generic Initial RT_{To} with Associated Initial Margin

Linde 80 Heat	Values Approved in BAW-2308, Rev. 1 SE		With Proposed ASTM E1921 Loading Rate Adjustment	
	IRT_{To} (°F)	Initial Margin σ_I (°F)	IRT_{To} (°F)	Initial Margin σ_I (°F)
406L44	-94.9	11.0	-98.0	11.6
71249	-47.4	12.9	-53.5	12.8
72105	-32.7	11.8	-31.1	13.7
821T44	-80.2	9.3	-84.2	9.6
299L44	-81.8	11.6	-74.3[a]	12.8[a]
72442	-30.0	11.9	-33.2	12.2
72445	-72.5	12.3	-72.5	12.0
61782[b]	---	---	-58.5	15.4
Other heats	-47.6	17.2	-48.6[a]	18.0[a]

a New data included
b New heat

6. Certification

This report is an accurate and true description of the fracture toughness characterization of Linde 80 weld materials and the results are accurately reported. The conclusions described are based on the data analysis presented.

J. B. Hall J B Hall 1-5-07
Materials and Structural Analysis Date

This report was reviewed and was found to be an accurate description of the work reported.

K. K. Yoon K. K. Yoon 1-5-07
Structural and Fracture Mechanics Date

Verification of independent review.

B. R. Grambau 1/5/07
Manager, Date
Materials and Structural Analysis

This report has been approved for release.

W. R. Gray 1/5/07
Program Manager, Date
PWR Owners Group - Materials Subcommittee

AREVA

7. References

1. K. K. Yoon and J. B. Hall, "Initial RT_{NDT} of Linde 80 Weld Materials," AREVA Document BAW-2308, Revision 0, July 2002 (ML022200555).

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