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May 22, 1992

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attn: Document Control Desk

Subject: Zion Station Units 1 and 2
Fracture Toughness Requirements
for Protection Against Pressurized
Thermal Shock Events - 10 CFR 50.61
NRC Docket Nos. 50-295 and 50-304

References:
(a) December 13, 1991 letter from R.J. Lezon to T.E. Murley
(b) March 13, 1992, letter from R.J. Lezon to T.E. Murley
(c) "Zion Specific WF-70/WF-209-1 Weld Metal Initial RT_{NDT} and RT_{PTS} Report", Commonwealth Edison Company, April 29, 1992.

Dear Dr. Murley:

Reference (a) provided an assessment of adjusted reference temperature, pressurized thermal shock (RT_{PTS}) values in accordance with the May 15, 1991 amendment to 10 CFR 50.61, for all six of Commonwealth Edison's pressurized water reactors. This submittal demonstrated that all RT_{PTS} values remain below the NRC screening criteria through end-of-design life (32 EFPY) with the exception of the intermediate-to-lower shell circumferential weld for Zion Unit 1. Pursuant to 10 CFR 50.61(4), reference (b) provided Commonwealth Edison's plans and implementation schedule for a flux reduction program to ensure that this weld will remain below the screening criterion through 32 EFPY. The purpose of this submittal is to provide Commonwealth Edison's re-assessment of end of life RT_{PTS} values for the Zion Unit 1 and 2 welds. This re-assessment, based upon weld metal specific data accumulated by the Babcock and Wilcox Owners Group (BAWOG), demonstrates that Zion Units 1 and 2 satisfy the 10 CFR 50.61 Pressurized Thermal Shock screening criteria through 32 EFPY.

The NRC Staff has asked the BAWOG to prepare a recommended regulatory position on the initial reference temperature, nil-ductility transition (RT_{NDT}) and RT_{PTS} for weld metal WF-70. Weld metal WF-70 is the limiting beltline weld metal of the Zion Unit 1 and 2 reactor pressure vessels (RPVs). The evaluation is based on the large amount of data the BAWOG has accumulated on the initial RT_{NDT} and the irradiation behavior of weld metal WF-70, its surrogate weld metal WF-209-1, and Linde 80 submerged arc weld metals in general.

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A generic report on WF-70 will be submitted by the BAWOG separately. Based on data provided by the BAWOG, the attached report (reference C) was prepared by Commonwealth Edison Company (CECo) to specifically address initial RT_{NDT} and RT_{PTS} for the Zion Unit 1 and Unit 2 RPVs. The CECo report shows that, using the available population of valid WF-70 and WF-209-1 data, Zion Units 1 and 2 satisfy the 10 CFR 50.61 PTS screening criteria through 32 EFPY. This was not previously the case for Zion Unit 1.

The RT_{PTS} value previously submitted by CECo (reference (a)) for the controlling weld metal of Zion Unit 1 at 32 EFPY was 309°F, using a chemistry factor of 211 based on a weld metal composition of 0.35% Cu and 0.59% Ni. The 10 CFR 50.61 screening criterion for this weld (circumferential) is 300°F. Using the BAWOG data with the Regulatory Guide 1.99 Rev. 2 Position 2 chemistry and margin factors, the RT_{PTS} value for the controlling weld of Zion Unit 1 at 32 EFPY is 267°F.

The RT_{PTS} value for the controlling weld metal of Zion Unit 2 was reported as 247°F at 32 EFPY in the previous submittal (reference (a) methodology). The 10 CFR 50.61 screening criterion for this weld (axial) is 270°F. Using the BAWOG data and Regulatory Guide 1.99 Rev. 2 Position 2 chemistry and margin factors, the RT_{PTS} value for the controlling weld of Zion Unit 2 at 32 EFPY is 217°F.

As a result of the revised initial RT_{NDT}, chemistry factor, and margin factor values presented in reference (c), a review of the Zion Unit 1 and 2 Technical Specification pressure-temperature (P-T) curves, low temperature overpressure protection (LTOP) system setpoints, and reactor vessel toughness data tables has been initiated. This review will be completed prior to startup from the current Unit 1 refuel outage. Should this review determine that changes to the Technical Specifications are necessary, CECo will submit the changes for NRC review and approval by 9-1-92. Any changes which result in P-T curves or LTOP setpoints which are more limiting than the current curves or setpoints will be implemented administratively in the interim period prior to NRC approval of the revised Technical Specifications.

CECo currently plans to proceed with the flux reduction program outlined in reference (b).

Please direct any questions you may have to this office.

Respectfully,

S. Sāmāc
Nuclear Licensing Administrator

Attachment

cc: A. Bert Davis, Regional Administrator - RIII
C.P. Patel, Project Manager - NRR
J.D. Smith, Senior Resident Inspector - Zion

ZNLD/1827/2

ZION-SPECIFIC

WF-70/WF-209-1 WELD METAL INITIAL RT_{NDT} AND RT_{PTS} REPORT

Introduction

The objective of this document is to provide an evaluation of weld metal WF-70 data with regard to initial RT_{NDT} and the shift in RT_{NDT} due to radiation embrittlement. The initial RT_{NDT} and the shift in RT_{NDT} will be used to calculate RT_{PTS} for Zion Station Units 1 and 2. The weld metal WF-70 specific information used for this report was provided by the BAWOG Materials Committee.

Submerged-arc weld metal WF-70 and the surrogate weld metal WF-209-1 fabricated with weld wire 72105 have demonstrated unique characteristics which set the weld metal apart from the other submerged-arc welds made with Mn-Ni-Mo filler wire/Linde 80 flux. This document will discuss the rationale used for selecting the initial RT_{NDT} value and the RT_{PTS} for the Zion reactor vessels.

Evaluation of Initial RT_{NDT}

All the available initial RT_{NDT} data for weld metals fabricated with 72105 weld wire are presented in Table 1. These data are identified as to their source and stress relief time.

Based on the data presented in Table 1, initial RT_{NDT} increases with increasing stress relief time. The effect of stress relief time is most pronounced above 40 hours. Since both Zion reactor vessels have total stress relief times of less than 35 hours at the beltline (WF-70) weld regions, it is reasonable to eliminate the higher stress relief time data. By eliminating all the data for stress relief times of 40 hours or greater, the mean initial RT_{NDT} is calculated to be 17.4°F (conservatively rounded up to 18°F for subsequent calculations), with a standard deviation of 20°F.

Evaluation of Shift of RT_{NDT}

Data Base - The surveillance data available for weld metals fabricated of 72105 constitutes one of the largest sets of data for an individual weld metal that exists in any data base. These fourteen individual data sets (fourteen separate irradiations from surveillance capsules) are presented in Table 2 and constitute all the data available up to the time of this report. All of the data have been verified by the BAWOG based on a thorough review of all source documents and the fluence values are based on current re-evaluations of the capsule fluences.

Irradiated Data Behavior - The data were evaluated on the basis of the 30 ft-lb temperature shift. These data were plotted as a function of fluence and are presented in Figure 1. For comparison, the trend curve for a chemistry factor of 211, based on 10CFR50.61 Table 1 for 0.35% copper and 0.59% nickel, is included in Figure 1 with the 30 ft-lb temperature shift data. This comparison demonstrates the extreme conservatism of the 10CFR50.61 methodology when compared to the actual 30 ft-lb temperature shift data.

The irradiated shift data were also analyzed using the procedure described in Regulatory Guide 1.99, Rev. 2, Position 2 for credible surveillance data. This approach calculated a chemistry factor of 174, which is the relationship of RT_{NDT} shift to fluence that fits the surveillance data. A trend curve based on the calculated chemistry factor of 174 is included in Figure 2 with the 30 ft-lb temperature shift data. A chemistry factor value of 174 will be used in this report for calculating RT_{PTS}.

RT_{PTS} Evaluation

Tables 3, 4, and 5 present RT_{PTS} values using three different approaches:

- Table 3 presents the RT_{PTS} values obtained using the May, 1991 version of 10CFR50.61 using the generic initial RT_{NDT} value of 0°F; a generic weld margin factor of 66°F; and a chemistry factor of 211, based on Table 1 of 10CFR50.61 with 0.35% Cu and 0.59% Ni. This does not take into account actual surveillance data, which would result in a lower chemistry factor and lower margin term.
- Table 4 presents RT_{PTS} values obtained using the May, 1991 version of 10CFR50.61, but with values of initial RT_{NDT} and chemistry factor obtained from surveillance data as in Regulatory Guide 1.99 Rev. 2, Position 2, and a margin factor of 56°F in accordance with 10CFR50.61 since a measured value of initial RT_{NDT} is used. This margin term is very conservative, since it does not take into account the standard deviation of the data set used to derive the initial RT_{NDT}.
- Table 5 presents the RT_{PTS} values obtained using the May, 1991 version of 10CFR50.61 as in Table 4, with values of initial RT_{NDT} and chemistry factor obtained from surveillance data, but with a margin factor calculated from Regulatory Guide 1.99 Rev. 2, Position 2. This methodology for margin factor is considered to be more appropriate than the margin specified in 10CFR50.61 for measured values of initial RT_{NDT}, because it uses the standard deviation of the data used to derive initial RT_{NDT}.

Summary:

Initial RT_{NDT} - From the results of this evaluation, the initial RT_{NDT} value to be used for the Zion Station Units 1 and 2 WF-70 beltline welds is calculated as:

Initial RT_{NDT} = 18°F

Standard Deviation = 20°F

These values are based on all the data available from weld metals fabricated with weld wire 72105, with stress relief times less than 40 hours.

Shift of RT_{NDT} - Using the methodology of Regulatory Guide 1.99 Rev. 2, Position 2, a chemistry factor of 174 was calculated for the fourteen data sets with wire heat number 72105. This chemistry factor is used in the determination of RT_{NDT} shift.

Margin Factor - A margin factor of 49, calculated using the methodology of Regulatory Guide 1.99 Rev. 2, Position 2, is considered to be appropriate because it takes into account the actual standard deviation of the data set used to determine RT_{NDT}.

RT_{PTS} Conclusion - This evaluation, based on the preceding values of initial RT_{NDT}, RT_{NDT} shift, and margin, concludes that the RT_{PTS} at 32 EFPY for Zion Unit 1 is 267°F, and for Zion Unit 2 is 217°F.

Table 1. Summary of Available Initial RT_{NDT} Data for Weld Metals Fabricated with Weld Wire 72105 and Linde 80 Flux

Source	Material	S.R. Time, Hrs.	RT_{NDT} F*
Oconee 2-RVSP	WF-209-1	33**	+ 7
Oconee 3-RVSP	WF-209-1	30**	+ 56
Zion 1-RVSP	WF-209-1	23**	+ 28
Zion 2-RVSP	WF-209-1	30**	- 3
B&WOG-RVSP	WF-70	48	+ 58
B&W-NBD	WF-70	48	+ 74
HSST-Series 3	WF-70	48	+123
Midland Beltline	WF-70	23**	+ 1
Midland Beltline	WF-70	23**	+ 16
Midland Beltline	WF-70	30**	+ 17
Midland Beltline	WF-70	40	+ 36
Midland Beltline	WF-70	50	+ 74

*RT_{NDT} defined per ASME Code NB-2331. In all cases the RT_{NDT} value is controlled by the Charpy 50 ft-lb temperature lower limit data.

** = values used in calculation of mean initial RT_{NDT} and standard deviation.

Table 2. Transition Temperature Data for Welds Fabricated With Weld Wire No. 72105
(Data available through 5-31-91)

Plant	Capsule Ident.	Weld Metal	Fluence n/cm^2	30 ft-lb Transition, Temp. F		
				Initial	Irradiated	Change
Surveillance Data						
Plant A	C	WF-209-1A	1.02E+18	+ 4	49	45
Plant A	A		3.37E+18	+ 4	118	114
Plant A	E		1.21E+19	+ 4	183	179
Plant B	A	WF-209-1B	8.10E+17	+45	93	48
Plant B	B		3.12E+18	+45	109	64
Plant B	D		1.45E+19	+45	185	140
Zion Unit 1	T	WF-209-1D	2.53E+18	+ 4	116	112
Zion Unit 1	U		8.49E+18	+ 4	203	199
Zion Unit 1	X		1.26E+19	+ 4	203	199
Zion Unit 1	Y		1.56E+19	+ 4	209	205
Zion Unit 2	U	WF-209-1E	2.57E+18	-23	122	145
Zion Unit 2	T		8.04E+18	-23	168	191
Zion Unit 2	Y		1.48E+19	-23	208	231
Owners Group	D1	WF-70	6.63E+18	+45	180	135

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Table 3. Evaluation of Zion Plant Reactor Vessel Pressurized Thermal Shock Criterion for 32 EFPY

Per 10CFR50.61 (May, 1991) Chemistry Factor and Generic Margin

Material Description			Material Chemical Composition, w/o		Estimated 32 EFPY Fluence Inside Surface	32 EFPY PTS Evaluation, F				
Reactor Vessel Beltline Region Location	Heat Number	Type	Copper	Nickel	m/cm^2	Initial RT_{NDT} F	Shift (Mean)	Generic Margin	RT_{PTS}	Screening Criterion
Zion Unit 1										
IS to LS Circum Weld (100%)	WF-70	ASA/Linde 80	0.35	0.59	1.73E+19	(0)	247	66	309	300
Zion Unit 2										
Interm. Longit. Weld (100%)	WF-70	ASA/Linde 80	0.35	0.59	6.04E+18	(0)	181	66	247	270

Table 4. Evaluation of Zion Plant Reactor Vessel Pressurized Thermal Shock Criterion for 32 EFPY

Per 10CFR50.61 (May, 1986) with RG 1.99 Rev. 2 Position 2 Chemistry Factor and 10CFR50.61 Plant-Specific Margin

Material Description			Material Chemical Composition, w/o		Estimated 32 EFPY Fluence Inside Surface n/cm^2	Per Regulatory Guide 1.99, Rev. 2 Position 2				
Reactor Vessel Beltline Region Location	Heat Number	Type	Copper	Nickel		Initial RT_{NDT}, F	Shift (Mean)	Margin	RT_{PTS}	Screening Criterion
Zion Unit 1 IS to LS Circum Weld (100%)	WF-70	ASA/Linde 80	0.35	0.59	1.73E+19	18	200	56	274	300
Zion Unit 2 Interm. Longit Weld (100%)	WF-70	ASA/Linde 80	0.35	0.59	6.04E+18	18	150	56	224	270

Table 5. Evaluation of Zion Plant Reactor Vessel Pressurized Thermal Shock Criterion for 32 EFPY

Per 10CFR50.61 (May, 1991) with RG 1.99 Rev. 2 Position 2 Chemistry Factor and Margin

Material Description			Material Chemical Composition, w/o		Estimated 32 EFPY Fluence Inside Surface	Per Regulatory Guide 1.99, Rev. 2 Position 2				
Reactor Vessel Beltline Region Location	Heat Number	Type	Copper	Nickel	n/cm^2	Initial RT_{NDT}, F	Shift (Mean)	Margin*	RT_{PTS}	Screening Criterion
Zion Unit 1										
IS to LS Circum Weld (100%)	WF-70	ASA/Linde 80	0.35	0.59	1.73E+19	18	200	49	267	300
Zion Unit 2										
Interm. Longit Weld (100%)	WF-70	ASA/Linde 80	0.35	0.59	6.04E+18	18	150	49	217	270

*Margin based on Reg. Guide 1.99, Rev. 2, Equation 4, with
Initial RT_{NDT} standard deviation = 20F
Delta RT_{NDT} standard deviation = 28F/2

Figure 1. Comparison of 10CFR50.61 Estimate of Radiation Shift. with Observed Shift for Surveillance Capsule Data for Welds Fabricated with Weld Wire 72105

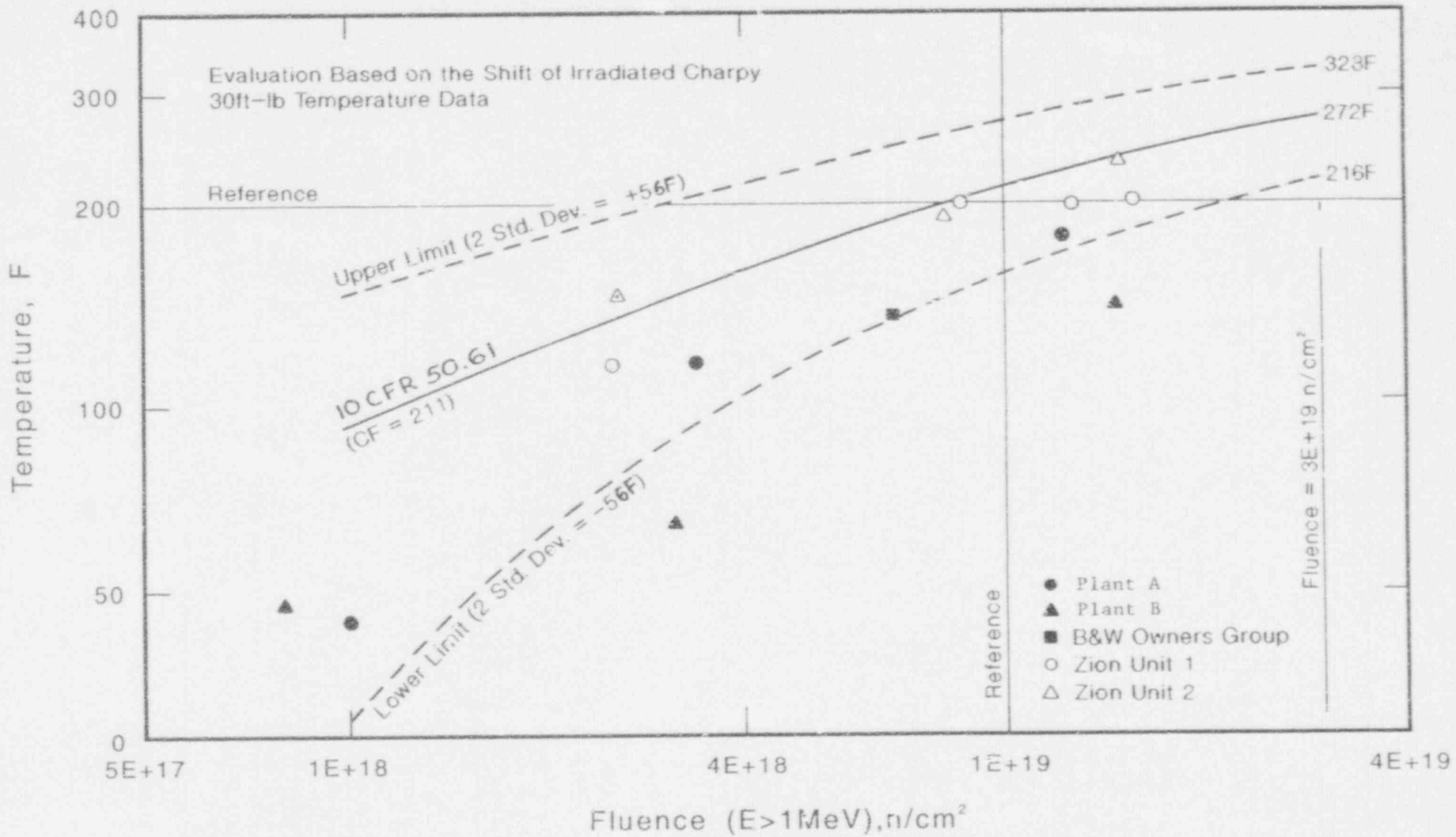

Figure 2. Comparison of Regulatory Guide 1.99, Revision 2, Position 2, Estimate of Radiation Shift, with Observed Shift for Surveillance Capsule Data for Welds Fabricated with Weld Wire 72105