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Dresden Generating Station
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ComEd

July 10, 1998

JMHLTR: #98-0195

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

Subject: Jet Pump Riser 15/16 Weld Flaw Evaluation
Dresden Nuclear Power Station, Unit 2
NRC Docket No. 50-237

References:

a) J.M. Heffley Letter #98-0115 to USNRC, Jet Pump Riser 15/16 Weld Flaw Evaluation Report, dated April 11, 1998

b) Request for Additional Information (RAI) for Dresden Nuclear Power Station, Unit 2 (TAC No. MA1672)," dated June 10, 1998

c) General Electric, GE Handbook GE-NE-523-B13-01869-054

d) Safety Evaluation of EPRI Report TR-106740, July 1996, "BWR Vessel and Internals Project, BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines (BWRVIP-18)," TAC No. M96219

The purpose of this letter is to provide the Commonwealth Edison (ComEd) Company response to the Request for Additional Information (RAI) in reference b. The reference b. RAI addresses the flaw analysis prepared by ComEd and provided to the NRC by reference a. This analysis addressed an IGSCC flaw identified during the In-Vessel Visual Inspection (IVVI) performed during the 15th refuel outage for Dresden Unit 2 (D2R15). The flaw was identified on the recirculation riser piping internal to the reactor vessel at the riser elbow to thermal sleeve, weld RS-1.

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Please direct any questions regarding this matter to Mr. Frank Spangenberg, Dresden Regulatory Assurance Manager at (815) 942-2920 extension 3800.

Sincerely,

Preston Swafford for.

J.M. Heffley
Site Vice President
Dresden Station

Attachments

cc: Dr. Carl Paperiello, Regional Administrator, Region III
Mark A. Ring, Branch Chief, Division of Reactor Projects, Region III
L. Rossbach, Project Manager, NRR (Unit 2/3)
K. R. Riemer, Senior Resident Inspector, Dresden
Office of Nuclear Safety – IDNS
File: Numerical

Attachment 1
Response to Request for Additional Information
Dresden Station Unit 2
50-237

Background

During the D2R15 refueling outage (March 1998), the IVVI inspection of the Unit 2 reactor pressure vessel internals included an examination of the five circumferential welds on each of the ten jet pump risers. This "augmented" inspection was performed in anticipation of the acceptance of the BWRVIP-41 recommendations and was deemed to be prudent in light of the flaws detected at other BWR's. The exam resulted in only one recordable indication, a 1.5″ flaw on the thermal sleeve to riser elbow weld (RS-1) to Jet Pump pair 15/16. An analysis had previously been performed by General Electric (reference c) that defined the extent to which this piping could tolerate flaws.

Technical Discussion

Question #1

Measurement uncertainty (page 8)-Provide the measurement uncertainty used in determining the measured flaw length. Explain how the uncertainty was established.

ComEd Response

The flaw was discovered and examined using an enhanced visual technique with a 0.0005″ wire resolution. It was sized using a graduated steel scale with 1/16″ increments. The flaw is less than 1.5″ in overall length and has been captured in a single image, a copy of which is attached. (Note: The photo has been reproduced from the SVHS file tape and has thus lost some resolution in reproduction.) The OD of the riser is reasonably flat over the tangential length of the flaw as shown on the photograph. Since the measured length was conservatively determined no additional uncertainty was required.

Question #2

Z Factor calculation (page 8 of attachment A)- The staff will consider the use of the proposed alternate Z Factor calculation as a long-term issue. Use 24" for the OD as specified in the ASME Code, and revise your analysis.

ComEd Response

ComEd acknowledges that the wording in Attachment A concerning the "Z" Factor calculation is confusing in its reference to earlier Editions of ASME Section XI Code requirements for Appendix C and "recent discussions in the Section XI Code Working Group on Pipe Flaw Evaluations."

The ASME Section XI Code has adopted the "Z" Factor formula as utilized in Attachment A into the 1996 Addenda (Table-3641-1, Note 2 and Appendix C). A copy of the "Technical Basis for Modification of ASME Section XI Articles IWB-3640 and Appendix C" is attached. In this Technical Basis, actual pipe tests as documented in NUREG/CR-4878, NUREG/CR-6298 and the International Piping Integrity Research Group Program (IPIRG-1) provides a conclusive basis for removing the conservative requirement of using a 24 inch diameter pipe "Z" Factor.

Since the methods for "Z" Factor formulation utilized in Attachment A by General Electric are the same as those employed by EPRI in BWRVIP-18, ComEd believes that the methods for "Z" Factor formulation in the subject analysis have been previously evaluated and accepted by the NRC in the SER of BWRVIP-18, reference d. ComEd maintains that the formula used for "Z" Factor in Attachment A is appropriate for this flaw evaluation and consistent with ASME Section XI pipe flaw evaluation requirements.

Question # 3

Z Factor calculation (page 9 of attachment A)-On page 9 it was stated that, "The examples of fluxed welds are submerged arc welds (SAW) and shielded metal arc welds (SMAW)." And since a non-flux process (SMAW) was specified for only part of the weld, it must be assumed that the welds are fluxed welds." However the Z formula for non-fluxed weld was still presented as the one used by GE. Clarify and explain if there was a typo in the text or a mistake in the Z Factor calculation.

ComEd Response

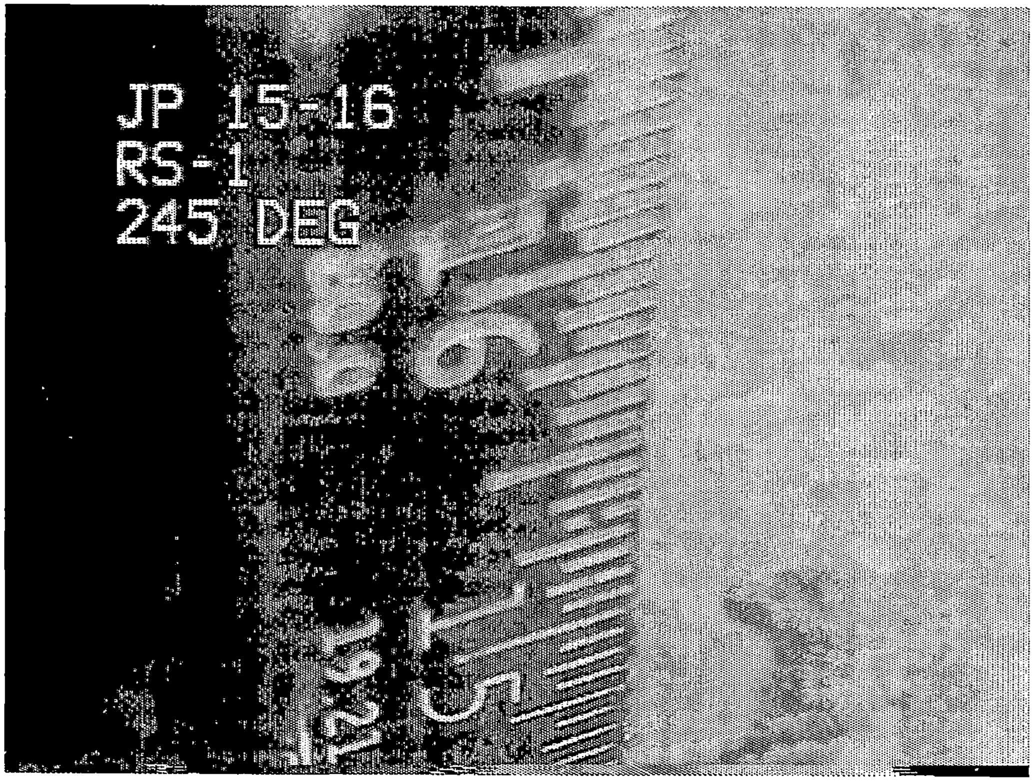
This is a typo in the GE Handbook. The "SM" should have been "GT." This is clarified in section 6.1 (page 11) of the Flaw Evaluation report.

Question #4

Crack Growth Evaluation (page 10 of attachment A)- Instead of providing the allowable crack size due to flow induced vibration (FIV), provide the crack growth due to FIV in two fuel cycles to be added to the evaluated flaw length of 4.7″.

ComEd Response

To clarify the information pertaining to Flow Induced Vibration (FIV) on page 10 of Attachment A, the evaluated flaw length of 4.7″ is not anticipated to grow due to FIV. This is based on the fact that the FIV stress intensity factor range, ΔK_{FIV}, for this flaw is below the stress intensity factor threshold for fatigue crack growth, $\Delta K_{th} = 3$ ksi $\sqrt{in}$.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TECHNICAL BASIS FOR MODIFICATION OF ASME SECTION XI ARTICLES IWB-3640 AND APPENDIX C
(Section XI - ISI Number 95-32)

by
Gery Wilkowski - Secretary of W.G. on Pipe Flaw Evaluation
and
Warren Bamford - Chairman - Chairman of Subgroup on Evaluation Standards

Background
The ASME Section XI austenitic pipe flaw evaluation criteria in Articles IWB-3640 and Appendix C were created initially to address the evaluation of IGSCC found in BWR piping. These criteria were developed in the mid-1980's. One of the concerns at that time was lower toughness of stainless steel shielded-metal arc (SMAW) and submerged-arc (SAW) welds relative to the base metal toughness. Elastic-plastic fracture mechanics analyses were developed that accounted for the lower toughness of the weld metal on the load-carrying capacity of a cracked pipe. This was employed into the Code by using a stress multiplier on the applied forces. This stress multiplier was called a Z-factor, and is simply the ratio of the maximum load from a limit-load solution to the elastic-plastic fracture mechanics solution maximum load. The Z-factors were found to be a function of the pipe diameter. The larger the pipe diameter, the larger the stress multiplier (Z-factor). One limitation imposed in the acceptance of IWB-3640 and Appendix C by the NRC was that if the pipe diameter was less than 24 inches, then the Z-factor for a 24-inch diameter pipe should be used. This conservatism was added due to a lack of full-scale pipe fracture data.

In the allowable flaw size solutions for circumferential cracks, the allowable depth of the crack is a function of applied loads. For wrought stainless steel pipe, the maximum allowable flaw depth is 75 percent of the thickness. Any flaw with a greater depth than 75 percent of the thickness at the end of the evaluation period is not allowed. Another limitation imposed on the acceptance of IWB-3640 and Appendix C criteria by the NRC was that for SAWs and SMAWs, the maximum acceptable flaw depth should be 60 percent of the thickness. Again this limitation was imposed due to a lack of sufficient data.

Since the time the austenitic pipe flaw evaluation criteria was originally developed, ferritic pipe flaw evaluation criteria have been implemented into the Code as Articles IWB-3650 and Appendix H. These criteria have a parallel development to the austenitic criteria. The ferritic pipe criteria were developed during the time that the NRC's Degraded Piping Program data(1) were available for validating the procedure. In these criteria, there were no restrictions on Z-factor for pipe diameter, and the maximum allowable flaw depths were the same for base and weld metals. Ferritic welds and base metals are lower in toughness than austenitic welds and base metals, hence there is an inconsistency in the austenitic and ferritic pipe flaw evaluation criteria.

Technical Basis for Change to IWB-3640 and Appendix C
One of the objectives of the Pipe Flaw Evaluation Working Group is to unify the austenitic and ferritic criteria. Pipe fracture experiments on austenitic SAWs and SMAWs have been available for some time now, and these data show that the earlier restrictions on the austenitic Z-factors and a/t limits can now be lifted. Some of these experiments are described in NUREG/CR-4878, "Analysis of Experiments on Stainless Steel Flux Welds", April 1987. The attached Table 5.4 from that NUREG report shows that the a/t values of these circumferential surface-cracked pipe experiments were from 0.642 to 0.684; that is, they all had depths greater than the current 0.6 limit. Furthermore, the results from Table 5.5 of that report (attached) show that when using the actual pipe diameter to calculate the Z-factors, the maximum experimental failure stress to Appendix C predicted failure stress ratios were all greater than 1.0, and had an average margin of 1.221.

An additional large diameter surface-cracked pipe experiment was conducted in the NRC's Short Cracks in Piping and Piping Welds program, summarized in NUREG/CR-6298 "Fracture Behavior of Short Circumferentially Surface-Cracked Pipe", November 1995. Table 4.11 from that report (attached) shows the parameters of the 28-inch diameter pipe experiment (Experiment 1.2.3.16). This was a shallower flaw experiment (a/t = 0.5), and as shown in Table 4.16 from that report (attached) the experimental maximum load to the Appendix C value was 1.33. Hence, there is a comparable margin for the small-diameter pipe experiments and the large-diameter pipe experiments when the actual pipe diameter is used in determining the Z-factor.

Finally, there is also a dynamic pipe system experiment on a 16-inch diameter pipe with a circumferential surface crack in an SAW that was conducted as part of the NRC's International Piping Integrity Research Group Program (IPIRG-1). A NUREG report is in preparation on this program, but the results are given in Reference 2. In this case the a/t was 0.635, which is again larger than the current 0.6 limit. When the actual pipe diameter is used in the Z-factor calculation, the maximum experimental failure stress to Appendix C predicted failure stress ratio is 1.31.

Hence, for austenitic pipes with circumferential surface cracks in SAWs, these data show that flaws deeper than the 0.6 a/t limit can be used and the failure loads are conservatively predicted using the Z-factor for the actual pipe diameter.

If you have any further questions, please contact either Dr. Gery Wilkowski at Battelle (614) 424-4680 or Mr. W. Bamford at Westinghouse (412) 374-6515.

Sincerely,

Dr. Gery M. Wilkowski
Secretary, WG-PFE

Mr. Warren Bamford
Chairman, SG-ES

References

(1) Wilkowski, G. M., and others, "Degraded Piping Program - Phase II", Summary of Technical Results and Their Significance to Leak-Before-Break and In-Service Flaw Acceptance Criteria, March 1984-January 1989, by Battelle Columbus Division, NUREG/CR-4082, Vol. 8, March 1989.

(2) Scott, P., Olson, R., and Wilkowski, G., "The IPIRG-1 Pipe System Fracture Tests -- Analytical Results", ASME PVP Vol. 280, June 1994, pp 153-165.

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NUREG/CR-4878

Table 5.4. Comparison of experimental results and IWB-3640 analysis for stainless steel submerged arc weld, surface-cracked pipe fracture experiments.

Experiment Number	Weld Procedure	Nominal Pipe Diameter, in (mm)	Wall Thickness, in (mm)	a/t	$2c/\pi D$	Axial Stress (σ_a), psi (MPa)	Maximum Experimental Bending Stress[a] ($\sigma_{b_{max}}$), psi (MPa)	Experimental/IWB-3640 Stress $\sigma_f=3S_m$[b]	$\sigma_f=3S_m$[c]
4141-2	SAW	6 (152)	0.584 (14.8)	0.642	0.5	6,200 (42.8)	23,990 (165.5)	0.86	1.34
4141-4	SAW	16 (406)	1.031 (26.3)	0.666	0.5	6,320 (43.6)	25,050 (172.8)	0.94	1.47
4141-6[d]	SAW (Solution-Annealed)	16 (406)	1.040 (26.4)	0.686	0.5	6,300 (43.5)	21,780 (150.3)	0.87	1.36

(a) Using expression $MD_o/2I$ for Class 1 piping where $I = 0.491 (D_o^4-D_i^4)$.
(b) Using Code values of base metal.
(c) Including Z-factor of 1.56.

Table 5.5. Calculated margins of safety for the ASME IWB-3640 analysis procedure[a]

Experiment Number	Diameter, in (mm)	Maximum Experimental/Predicted Stress Using Class 1 Piping Stress Equations: Using Z-Factor with 24-inch (611-mm)-Diameter Lower Limit	Maximum Experimental/Predicted Stress Using Class 1 Piping Stress Equations: Using Z-Factor with Actual Diameter	Experimental/Predicted Stress Using Class 2 Piping Stress Equations: Using Z-Factor with 24-inch (611-mm)-Diameter Lower Limit	Experimental/Predicted Stress Using Class 2 Piping Stress Equations: Using Z-Factor with Actual Diameter
Through-Wall-Cracked Pipe					
4141-1	6 (152)	1.422	1.212	1.307	1.114
4141-5	6 (152)	1.261	1.075	1.162	0.991
4141-3	16 (406)	1.198	1.118	1.184	1.105
4111-5	28 (711)	1.003	1.003	0.980	0.980
TWC Average		1.221 (1.294)[b]	1.101 (1.135)[b]	1.158 (1.218)[b]	1.048 (1.070)[b]
Surface-Cracked Pipe					
4141-2	6 (152)	1.340	1.142	1.080	0.921
4141-4	16 (406)	1.470	1.253	1.212	1.131
4141-6	16 (406)	1.360	1.269	1.167	1.089
SC Average		1.390	1.221	1.153	1.047
Average		1.293 (1.342)[b]	1.153 (1.178)[b]	1.156 (1.185)[b]	1.047 (1.058)[b]
Standard Deviation		0.157 (0.100)[b]	0.097 (0.078)[b]	0.103 (0.074)[b]	0.082 (0.084)[b]
95-Confidence Level		0.979 (1.141)[b]	0.959 (1.022)[b]	0.950 (1.037)[b]	0.882 (0.891)[b]

(a) Margin of safety = maximum experimental/predicted stress without IWB-3640 safety factors.
(b) Excluding Experiment 4111-5 on 28-inch (711-mm)- diameter pipe with SMAW.

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NUREG/CR-4878

Table 4.11 List of surface-cracked-pipe experiments analyzed - combined bending and pressure load cases

Ref.[a] No.	Expt. No.	Material	Outer Pipe Diameter, mm	(inch)	Pipe Wall Thickness, mm	(inch)	Pipe Internal Pressure, MPa	(psi)	Test Temperature, C	(F)	Surface Flaw Dimensions, θ/π	a/t
29	4131-2	TP304	168	(6.627)	13.4	(0.529)	24.5	(3,550)	288	(550)	0.521	0.709
30	4131-4	A333 Gr. 6	273	(10.74)	16.6	(0.654)	18.3	(2,650)	288	(550)	0.525	0.659
31	4141-2	TP304 SAW	167	(6.582)	14.8	(0.584)	15.2	(2,200)	288	(550)	0.500	0.642
32	4141-4	TP304 SAW	414	(16.28)	26.2	(1.031)	11.0	(1,600)	288	(550)	0.500	0.670
33	4141-6	TP304 SAW	416	(16.39)	26.4	(1.040)	11.0	(1,600)	288	(550)	0.500	0.686
34	4141-8	A106B SAW	403	(15.87)	25.4	(0.999)	15.5	(2,250)	288	(550)	0.500	0.670
39	4143-2	Aged CF8M	325	(12.80)	31.1	(1.225)	15.5	(2,250)	288	(550)	0.500	0.653
40	4143-1	Aged CF8M	400	(15.73)	26.4	(1.037)	15.5	(2,250)	288	(550)	0.500	0.550
41	4143-3	Aged CF8M Weld	322	(12.66)	29.6	(1.167)	15.5	(2,250)	288	(550)	0.580	0.660
42	1.1-7	A106 Gr. B	168	(6.594)	13.5	(0.531)	15.5	(2,250)	288	(550)	0.432	0.647
43	1.1-9	A106 Gr. B	167	(6.589)	14.0	(0.552)	15.5	(2,250)	288	(550)	0.419	0.720
44	4.3-2	STS-49	765	(30.12)	39.0	(1.535)	9.10	(1,320)	300	(572)	0.166	0.498
45	1.2.1.20[b]	TP304	406	(16.01)	9.50	(0.374)	1.55	(225)	93	(200)	0.250	0.476
46	1.2.3.15[b]	A516 Gr. 60	711	(28.0)	22.7	(0.893)	9.56	(1,387)	288	(550)	0.250	0.500
47	1.2.3.16[b]	TP316L SAW	711	(28.0)	30.2	(1.190)	10.1	(1,470)	288	(550)	0.250	0.500
48	1.2.3.17[b]	A106 Gr. B SAW	610	(24.0)	42.7	(1.680)	15.5	(2,250)	288	(550)	0.250	0.605

(a) Experiments with Reference Numbers 35-38 involved weld overlay repairs and were excluded from the analyses in this table.
(b) Experiments conducted during this program.

Table 4.16 Comparison of experimental maximum moment with analytical predictions for combined bending and pressure load cases

Ref. No.	Expt. No.	Expt. Maximum Moment, kN-m	(in-kips)	Experimental Maximum Stress/Predicted Maximum Stress[a], SC.TNP1	SC.TNP2	SC.TKP1	SC.TKP2	SC.ENG1	SC.ENG2	R-6	Sec XI App C	Sec XI App H	Sec XI Code Case N-494-2	DPZP
29	4131-2	34.1	(301.9)	1.17	1.51	2.20	1.87	1.54	1.87	(b)	1.18	N.A.[c]	N.A.	1.24
30	4131-4	160	(1,416)	1.07	1.41	1.69	1.51	1.37	1.61	1.60	N.A.	2.02	1.30	1.07
31	4141-2	41.1	(364.0)	1.35	1.72	2.08	1.80	1.72	2.00	1.72	1.34	N.A.	N.A.	0.97
32	4141-4	502	(4,439)	1.33	1.76	2.15	1.90	1.73	2.10	1.64	1.47	N.A.	N.A.	1.02
33	4141-6	445	(3,942)	1.12	1.47	1.82	1.61	1.45	1.78	1.44	1.36	2.47	N.A.	0.92
34	4141-8	595	(5,260)	1.18	1.53	1.93	1.66	1.61	1.93	1.75	N.A.	1.11	1.63	1.15
39	4143-2[d]	386	(3,414)	1.31	1.52	1.67	1.40	1.68	1.89	1.55	0.98	N.A.	N.A.	0.99
40	4143-1	672	(5,949)	1.01	1.29	1.41	1.23	1.22	1.38	1.49	1.07	N.A.	N.A.	0.99
41	4143-3[d]	410	(3,625)	1.52	1.78	2.22	1.85	2.06	2.28	1.92	1.21	N.A.	N.A.	1.21
42	1.1-7	77.2	(683.3)	1.06	1.38	1.54	1.38	1.29	1.56	1.41	N.A.	2.15	1.46	1.05
43	1.1-9	61.6	(545.2)	0.92	1.20	1.44	1.29	1.16	1.51	1.25	N.A.	1.89	1.26	0.92
44	4.3-2	7,201	(63,736)	0.98	1.26	1.01	0.87	1.13	1.39	1.52	N.A.	2.68	1.68	1.08
45	1.2.1.20[e]	356	(3,154)	0.77	0.99	1.01	0.89	0.78	0.89	0.88	0.75	N.A.	0.97	0.84
46	1.2.3.15	2,190	(19,380)	0.85	1.08	0.90	0.81	0.90	1.04	1.21	N.A.	1.95	N.A.	0.84
47	1.2.3.16	2,094	(18,533)	1.02	1.28	1.16	0.99	1.21	1.43	1.45	1.33	N.A.	N.A.	1.00
48	1.2.3.17	2,575	(22,790)	0.92	1.15	1.00	0.86	1.18	1.48	1.26	N.A.	1.83	1.43	1.12
			Average[f]	1.10	1.41	1.38	1.21	1.39	1.65	1.43	1.16	2.14	1.42	1.05
			Std. Dev.[f]	0.15	0.20	0.52	0.45	0.30	0.34	0.40	0.19	0.29	0.18	0.13

(a) $(\sigma_{B_{EXPT}} + \sigma_{M_{EXPT}}) / (\sigma_{B_{PRED}} + \sigma_{M_{PRED}})$
(b) For Experiment 4131-2, the R6 analysis predicts failure due to internal pipe pressure alone.
(c) N.A. - Not applicable.
(d) $R_i/t < 5$.
(e) $R_i/t > 20$.
(f) The average and standard deviations for the SC.TNP and SC.TKP analyses are calculated for those experiments for which the R_i/t ratios are between 5 and 20 which is the region where the H- and G_N-functions are tabulated in the SC.TNP and SC.TKP analyses, respectively.

COMMITTEE CORRESPONDENCE

committee: ASME, SECTION XI WORKING GROUP ON PIPE FLAW EVALUATION

subject: Minutes of the March 4, 1996 Meeting in Charlotte, N.C.

date: April 9, 1996

to: Attendees

address writer care of: Battelle
505 King Avenue
Columbus, Ohio
43201-2693

copy to: Membership

Present at the meeting were:

G. M. Wilkowski - Battelle
K. K. Yoon - B&W Nuclear Technology
G. DeBoo - Commonwealth Edison
W. H. Bamford - Westinghouse
R. Cipolla - Aptech
L. C. Rinaca - TVA
J. Wong - Consumers Power
A. Lee - NRC
K. Iida - Advisor for JAPEIC
D. Jackson - NRC-RES
Y. Imamura - MHI Kobe
V. Zilberstein - Stone & Webster
J. Bloom - B&W R&D Center
H. Mehta - GE Nuclear Energy
J. Panesar - AECL Canada
M. Davis - Duke Power
M. Langel - Duke Power
K. Wichman - NRC-NRR
E. Friedman - Westinghouse Bettis
C. Ross - Nuclear Electric - Barnwood
K. Moser - Houston Light and Power

ferritic curve. Bloom seconded the motion. Wilkowski then called for discussion, and the following discussion ensued.

J. Panesar asked how the R_m/t limit compares to the Code Case N-494-3b curve. Wilkowski showed that the R_m/t of 15 curve was a curve between the Battelle R_m/t curves of 10 and 20, see Attachment 16. Bloom noted that most of the applications for Class 1 pipe will be for S_r values greater than 1.0, so that the R_m/t limit of 15 should be acceptable, see Page 2 in Attachment 14.

Panesar then inquired about the validity of the R_m/t limit of 15 for ferritic pipe. Wilkowski and Bloom then created a figure showing the Code Case N-494-2 FAD curve on the Battelle R_m/t FAD curve, see Page 3 of Attachment 16. This showed that the Code Case N-494-2 curve was below the Battelle incremental plasticity FAD curves for all R_m/t values. Bloom inquired if there should be a different limit for ferritic pipe, but the group wanted to keep the R_m/t limit the same for both austenitic and ferritic pipe.

Wilkowski then reaffirmed that all were happy with the R_m/t limit of 15, that there were no further questions or discussion, and then called for the vote. A voice vote was taken and the motion passed unanimously.

W. Bamford then said the following steps were for him to get a copy of the N-494-3b curve and where the R_m/t limitation words should be included. A vote in the Subgroup was needed since this is a technical change. Bamford will then handle taking the Code Case up further. Bloom was to supply Bamford with the necessary information. ***(Action Item - Bloom)***

Wilkowski will then draft a short technical basis document on the R_m/t limit, and will pass it by Bloom for modification. This document will be presented at the next meeting and then this item will be closed. ***(Action Item - Wilkowski)***

<u>Item 6.0 - PFE-91-3: Evaluation Approaches for EPFM</u>

Item 6.1 - Priority 2 and 3 Items from May 1995 Meeting

⇒ **Item 6.1a - Basis for ISI-95-32 Changes for Austenitic Z-factors and Allowable a/t (Bamford)**

W. Bamford noted that the changes have been approved all the way up the Section XI Subcommittee, but he has not written the technical basis document yet. It was determined that this technical basis document should be written by Bamford and Wilkowski within the week, after this meeting, for the Main Committee ballot to approve the changes. ***(Action Item - Wilkowski and Bamford.)***

(Secretary note: this action item was completed shortly after the meeting. The technical basis document for this change is given in Attachment 17.)

Attachment 17

Technical Basis Document for Recent Changes to IWB-3640 and Appendix C

Item 6.1a

by

G. Wilkowski, Battelle-Columbus

and

W. Bamford, Westinghouse