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Docket Number 50-346

License Number NPF-3

Serial Number 2343

November 14, 1995

United States Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555-0001

Subject: Response to Generic Letter 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity", for the Davis-Besse Nuclear Power Station

Ladies and Gentlemen:

This letter provides Toledo Edison's (TE) response for the Davis-Besse Nuclear Power Station, Unit 1 (DBNPS), to Nuclear Regulatory Commission (NRC) Generic Letter 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity," dated May 19, 1995. By letter dated August 16, 1995, (TE Serial Number 2314), Toledo Edison provided its initial response to Part 1 of the Generic Letter. In the response, Toledo Edison identified its support of the B&W Owners Group Reactor Vessel Working Group efforts to obtain additional data which could be relevant to the determination of reactor pressure vessel (RPV) integrity, and provided acceptance of B&W Owners Group report BAW-2257, "Response to Part (1) of Generic Letter 92-01, Revision 1, Supplement 1", submitted to the NRC by letter dated August 1, 1995 (reference: OG-95-1527).

The Generic Letter required the following information also be provided to the NRC:

"(2) an assessment of any change in best-estimate chemistry based on consideration of all relevant data;

(3) a determination of the need for use of the ratio procedure in accordance with the established Position 2.1 of Regulatory Guide 1.99, Revision 2, for those licensees that use surveillance data to provide a basis for the RPV integrity evaluation; and

(4) a written report providing any newly acquired data specified above and (1) the results of any necessary revisions to the evaluation of RPV integrity in accordance with the requirements of 10 CFR 50.60, 10 CFR 50.61, Appendices G and H to 10 CFR Part 50, and any potential impact on the LTOP or P-T limits in the technical specifications or (2) a certification that previously submitted evaluations remain valid. Revised evaluations and certifications should include consideration of Position 2.1 of Regulatory Guide 1.99, Revision 2, as applicable, and any new data."

Toledo Edison has accepted the attached B&W Owners Group Topical Report BAW-2257, Revision 1, "Response to Generic Letter 92-01, Revision 1, Supplement 1", submitted to the NRC by letter dated November 1, 1995, (reference OG-95-1552). This response was prepared by the B&W Nuclear Technologies Company for the B&W Owners Group Reactor Vessel Working Group; provides responses for Parts 2, 3 and 4; and completes the response for Part 1.

Toledo Edison also certifies that previously submitted DBNPS reactor vessel integrity calculations remain valid. These evaluations include low temperature overpressure protection (LTOP) and pressure-temperature (P-T) limit curves in the Technical Specifications (reference: DBNPS License Amendment 199 dated July 20, 1995) and previous responses to GL 92-01 (reference: Toledo Edison Serial Number 2060 dated July 1, 1992, and Serial Number 2233 dated June 30, 1994).

Should you have any questions or require additional information, please contact Peter W. Smith, acting Manager - Regulatory Affairs, at (419) 321-7744.

Very truly yours,

DHL

Enclosure
Attachment

cc: L. L. Gundrum, DB-1 NRC/NRR Project Manager
H. J. Miller, Regional Administrator, NRC Region III
S. Stasek, DB-1 NRC Senior Resident Inspector
Utility Radiological Safety Board

RESPONSE TO GENERIC LETTER 92-01 REVISION 1, SUPPLEMENT 1

FOR

DAVIS-BESSE NUCLEAR POWER STATION

UNIT NUMBER 1

This letter is submitted in conformance with Section 182a of the Atomic Energy Act of 1954 as amended, and 10CFR50.54(f). Enclosed is Toledo Edison's Response to Generic Letter 92-01, Revision 1, Supplement 1, Reactor Vessel Structural Integrity, for the Davis-Besse Nuclear Power Station .

By: [signature]
John P. Stetz, Vice President - Nuclear

Sworn to and subscribed before me this 14th day of November, 1995.

Lori J. Strauss
Notary Public, State of Ohio

LORI J. STRAUSS
Notary Public, State of Ohio
My Commission Expires 3/22/98

Docket Number 50-346
License Number NPF-3
Serial Number 2343
Attachment

Topical Report BAW-2257, Revision 1

B&W Owners Group Reactor Vessel Working Group

Response to Generic Letter 92-01, Revision 1, Supplement 1

EXT- 95-02600

BAW-2257, Revision 1
October 1995

THE B&W OWNERS GROUP

MATERIALS COMMITTEE

B&W Owners Group Reactor Vessel Working Group Response to Generic Letter 92-01, Revision 1, Supplement 1

B&W NUCLEAR TECHNOLOGIES

BAW-2257, Revision 1
October 1995

B&W Owners Group Reactor Vessel Working Group
Response to Generic Letter 92-01, Revision 1, Supplement 1

by

M. J. DeVan

BWNT Document No. 43-2257-01
(See Section 5 for document signatures.)

Prepared for

B&W Owners Group Reactor Vessel Working Group
Commonwealth Edison Company
Duke Power Company
Entergy Operations, Inc.
Florida Power Corporation
Florida Power & Light Company
GPU Nuclear Corporation
Rochester Gas and Electric Corporation
Toledo Power Company
Virginia Power
Wisconsin Electric Power Company

Prepared by

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Lynchburg, Virginia 24506-0935

CONTENTS

1.0 INTRODUCTION

This document provides the Owners Group response to the Nuclear Regulatory Commission (NRC) Generic Letter 92-01, Revision 1, Supplement 1, for the B&W Owners Group Reactor Vessel Working Group member plants listed below.

Generic Letter 92-01, Revision 1, Supplement 1, was issued by the NRC on May 19, 1995 and addressed to all holders of nuclear power plant operating licensees. The generic letter was issued to ensure that all licensees have all of the data relevant to the evaluation of structural integrity of their reactor vessels and that all such data is appropriately included in their assessments of compliance with regulatory requirements regarding reactor vessel integrity. The requests for information in Generic Letter 92-01, Supplement 1, are divided into four parts, and written responses are required as follows:

Part 1:	within 90 days of the issue date of the generic letter (deadline of August 17, 1995), and
Parts 2, 3, and 4:	within 6 months of the issue date of the generic letter (deadline of November 19, 1995).

This document provides the required information in Generic Letter 92-01, Revision 1, Supplement 1, for the following plants:

Plant	Owner
Arkansas Nuclear One Unit 1	Entergy Operations, Inc.
Crystal River Unit 3	Florida Power Corporation
Davis-Besse	Toledo Edison Company
R. E. Ginna	Rochester Gas and Electric Corporation
Oconee Unit 1	Duke Power Company
Oconee Unit 2	Duke Power Company
Oconee Unit 3	Duke Power Company
Point Beach Unit 1	Wisconsin Electric Power Company
Point Beach Unit 2	Wisconsin Electric Power Company
Surry Unit 1	Virginia Power
Surry Unit 2	Virginia Power
Three Mile Island Unit 1	GPU Nuclear Corporation
Turkey Point Unit 3	Florida Power & Light Company
Turkey Point Unit 4	Florida Power & Light Company
Zion Unit 1	Commonwealth Edison Company
Zion Unit 2	Commonwealth Edison Company

Revision 1 of this report provides the Owners Group response to Parts (2), (3), and (4). The response to Part (1), which is included herein, was provided in the Revision 0 of this report dated July 1995.

2.0 STATEMENT OF RESPONSE

2.1 Part (1) to NRC Generic Letter 92-01, Revision 1, Supplement 1

Part (1) of the Generic Letter requires the Addressees to provide the following information:

> "a description of those actions taken or planned to locate all data relevant to the determination of RPV integrity, or an explanation of why the existing data base is considered complete as previously submitted"

<u>B&W Owners Group Reactor Vessel Working Group Response to Part (1)</u>

The B&W Owners Group's Materials Committee initiated efforts in 1977 to resolve the reactor vessel integrity issue for high copper, Linde 80, automatic submerged arc welds. Its successor organization, the B&W Owners Group's Reactor Vessel Working Group (RVWG), has continued these efforts to acquire and document relevant data for determining reactor vessel integrity of its member plants. Appendix A provides a list of documents that are in the possession of the NRC and were considered in the development of the previous RVWG responses to Generic Letter 92-01, Revision 1 and associated requests for additional information.

Information for these documents was obtained from the following sources:

- Babcock & Wilcox fabrication documentation (e.g., weld qualification reports)
- Investigations sponsored by:
  - B&W Owners Group
  - Electric Power Research Institute (EPRI)
  - NRC (at the Oak Ridge National Laboratory)
- Reactor vessel material surveillance program reports

The RVWG's Master Integrated Reactor Vessel Material Surveillance Program (MIRVP) links all the operating PWRs that contain high copper, Linde 80 welds and makes careful note of where the same weld, or its surrogate, is used in more than one reactor vessel. These data are shared for regulatory analyses regarding reactor vessel integrity.

A review of the list of reactor vessels fabricated by Babcock & Wilcox indicates that additional weld chemistry and initial Charpy V-notch and Drop Weight impact toughness data from a few domestic BWR and foreign PWR vessels may be available. Nevertheless, the RVWG believes that the available data, relevant to the assessment of its member plant vessels, have been appropriately considered in the submitted reactor vessel integrity evaluations.

A review of available data sources for B&W-fabricated reactor vessels (domestic and foreign) shows all available data have been considered in establishing the chemistry values for the Linde 80, ASA welds. Therefore, no change in the previously reported weld metal chemistry values is required for Linde 80 weld wires.

2.2 Part (2) to NRC Generic Letter 92-01, Revision 1, Supplement 1

Part (2) of the Generic Letter requires the Addressees to provide the following information:

> "an assessment of any change in best-estimate chemistry based on consideration of relevant data;"

<u>B&W Owners Group Reactor Vessel Working Group Response to Part (2)</u>

The B&W Owners Group (B&WOG) performed extensive work to establish the chemical composition of beltline welds using the automatic submerged-arc (ASA) process, copper-plated Mn-Mo-Ni filler wire, and Linde 80 flux.[1,2,3] The work included collecting existing sources of chemistry data, performing extensive chemical analyses on archive production reactor vessel weld metals (from nozzle belt "dropouts" and surveillance welds) and developing predictive methods with the aid of statistical analyses. The results of the above work are considered to be the appropriate "best-estimate" chemical composition values representative of the high copper ASA/Linde 80 beltline welds.

A review of available data sources for B&W-fabricated reactor vessels (domestic and foreign) shows all available data have been considered in establishing the chemistry values for the Linde

80, ASA welds. Therefore, no change in the previously reported weld metal chemistry values is required for Linde 80 weld wires.

2.3 Part (3) to NRC Generic Letter 92-01, Revision 1, Supplement 1

Part (3) of the Generic Letter requires the Addressees to provide the following information:

> "a determination of the need for use of the ratio procedure in accordance with the established Position 2.1 of Regulatory Guide 1.99, Revision 2, for those licensees that use surveillance data to provide a basis for the RPV integrity evaluation;"

B&W Owners Group Reactor Vessel Working Group Response to Part (3)

Position 2.1 of Regulatory Guide 1.99, Revision 2, states

> "if there is clear evidence that the copper or nickel contents of the surveillance weld differs from that of the vessel weld, measured values of ΔRT_{NDT} should be adjusted by multiplying them by the ratio of the chemistry factor for the vessel weld to that for the surveillance weld."

The B&WOG RVWG position is that the variability in chemical composition between the individual surveillance weld sources for a particular weld wire heat is representative of the chemical variability in the reactor vessel beltline welds; therefore, the RVWG will continue to use surveillance data when available in accordance with Position 2.1 of Regulatory Guide 1.99, Revision 2, without applying the ratio procedure.

The B&WOG RVWG has reviewed the potential impact of using the ratio procedure on the limiting weld in their reactor vessels and concludes that even though the chemistry factors may differ from the chemistry factors calculated based on the average weld wire chemistry, the RT_{PTS} values do not change significantly as defined in 10CFR50.61 (i.e., does not exceed the screening criteria). These differences are presented in Table 2-1 along with their respective RT_{PTS} values; these values are presented for information only and do not necessarily reflect plant-specific data previously submitted for plant licensing. (The supporting information for the development of Table 2-1 is presented in Appendix B.)

2.4 Part (4) to NRC Generic Letter 92-01, Revision 1, Supplement 1

Part (4) of the Generic Letter requires the Addressees to provide the following information:

> "a written report providing any newly acquired data as specified above and (1) the results of any necessary revisions to the evaluation of RPV integrity in accordance with the requirements of 10CFR50.60, 10CFR50.61, Appendices G and H to 10CFR Part 50, and any potential impact on the LTOP or P-T limits in the technical specifications or (2) a certification that previously submitted evaluations remain valid. Revised evaluations and certifications should include consideration of Position 2.1 of Regulatory Guide 1.99, Revision 2, as applicable, and any new data."

B&W Owners Group Reactor Vessel Working Group Response to Part (4)

Since the chemical variability in the Linde 80 weld surveillance data is represented by the variability observed in the Charpy surveillance data used to establish the chemistry factors for the weld wire heats in the RVWG beltline welds, and no new chemistry or mechanical information is available for these weld metals, the previously submitted reactor vessel integrity evaluations (i.e., plant-specific LTOP and P-T limit curves in plant technical specifications and RVWG evaluations of reactor vessel integrity in accordance with the requirements of 10CFR50.60, 10CFR50.61, and Appendices G and H to 10CFR Part 50) remain valid.

Table 2-1. Effect on Projected Values of RT_{PTS} of Applying Ratio Procedure of Regulatory Guide 1.99, Revision 2, Position 2.1

Plant (1)	Weld Wire (Weld Id.) (2)	Chem. Factor (3)	Ratio Chem. Factor (4)	RT_{PTS} (5)	Ratio RT_{PTS} (6)	Screening Criteria (7)
ANO-1	821T44 (WF-182-1)	162.1	170.7	156.3	164.5	300
	406L44 (WF-112)	175.0	184.5	173.0	182.4	300
CR3	71249 (SA-1769)	N/A*	N/A*	N/A*	N/A*	300
	72105 (WF-70)	138.4	136.6	132.3	130.6	300
DB	821T44 (WF-182-1)	162.1	170.7	166.2	174.9	300
REG	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
	61782 (SA-847)	147.2	152.1	198.0	204.5	300
OC1	61782 (SA-1135)	147.2	152.1	67.4	69.6	300
	71249 (SA-1229)	N/A*	N/A*	N/A*	N/A*	300
	72445 (SA-1585)	149.8	143.8	144.8	139.0	300
OC2	406L44 (WF-154)	175.0	184.5	167.6	176.6	300
	299L44 (WF-25)	216.9	231.4	212.7	226.8	300
OC3	821T44 (WF-200)	162.1	170.7	154.3	162.5	300
	72442 (WF-67)	N/A*	N/A*	N/A*	N/A*	300
PB1	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
	61782 (SA-847)	147.2	152.1	168.1	173.6	270
PB2	72442 (SA-1484)	N/A*	N/A*	N/A*	N/A*	300
S1	72445 (SA-1585)	149.8	143.8	203.8	195.7	300
	299L44 (SA-1526)	216.9	231.4	190.6	203.2	270
S2	72445 (SA-1585)	149.8	143.8	136.7	131.3	270
TMI-1	72105 (WF-70)	138.4	136.6	130.8	129.1	300
	299L44 (WF-25)	216.9	231.4	208.8	222.7	300
	299L44 (SA-1526)	216.9	231.4	201.8	215.3	270
TP3	72442 (SA-1484)	N/A*	N/A*	N/A*	N/A*	300
	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
TP4	72442 (WF-67)	N/A*	N/A*	N/A*	N/A*	300
	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
Z1	406L44 (WF-154)	175.0	184.5	185.3	195.3	300
	72105 (WF-70)	191.5	227.8	221.9	263.7	300
Z2	821T44 (WF-200)	162.1	170.7	174.9	184.2	300
	72105 (WF-70)	191.5	227.8	166.0	197.2	270
	71249 (SA-1769)	N/A*	N/A*	N/A*	N/A*	300

* Surveillance data not used to calculate chemistry factor/RT_{PTS} value.

Notes to Table 2-1:

(1)	ANO-1	- Arkansas Nuclear One Unit 1
	CR3	- Crystal River Unit 3
	DB	- Davis-Besse
	REG	- R. E. Ginna
	OC1	- Oconee Unit 1
	OC2	- Oconee Unit 2
	OC3	- Oconee Unit 3
	PB1	- Point Beach Unit 1
	PB2	- Point Beach Unit 2
	S1	- Surry Unit 1
	S2	- Surry Unit 2
	TMI-1	- Three Mile Island Unit 1
	TP3	- Turkey Point Unit 3
	TP4	- Turkey Point Unit 4
	Z1	- Zion Unit 1
	Z2	- Zion Unit 2

(2) Weld wire heat number with weld identifications where surveillance data is available.

(3) Chemistry factor in accordance with 10CFR50.61 without using ratio procedure (see Appendix B, Table A-1, pages B-27 through B-29).

(4) Chemistry factor with application of Regulatory Guide 1.99, Revision 2, Position 2.1, ratio procedure (see Appendix B, Table B-1, pages B-31 through B-33).

(5) Predicted RT_{PTS} value in accordance with proposed 10CFR50.61, Federal Register, October 4, 1994 (see Appendix B, Table 7, pages B-17 and B-18).

(6) Predicted RT_{PTS} value in accordance with proposed 10CFR50.61, Federal Register, October 4, 1994 and using "ratioed chemistry factor" in accordance with Regulatory Guide 1.99, Revision 2, Position 2.1 (see Appendix B, Table 10, pages B-24 and B-25).

(7) Screening criteria in accordance with 10CFR50.61.

3.0 CONCLUSION

The B&W Owners Group (B&WOG) Reactor Vessel Working Group (RVWG) written responses for the requested information in Parts (1), (2), (3), and (4) of NRC Generic Letter 92-01, Revision 1, Supplement 1, are provided in Section 2 of this document. Based on the content of these responses, Generic Letter 92-01, Revision 1, Supplement 1, is considered complete for the B&WOG RVWG.

4.0 REFERENCES

1. K. E. Moore and A. S. Heller, "Chemistry of 177-FA B&W Owners' Group Reactor Vessel Beltline Welds," BAW-1500P, Babcock & Wilcox's Power Generation Group, Nuclear Power Generation Division, Lynchburg, Virginia, September 1978.*

2. K. E. Moore and A. S. Heller, "B&W 177-FA Reactor Vessel Beltline Weld Chemistry Study," BAW-1799, Babcock & Wilcox's Utility Power Generation Division, Lynchburg, Virginia, July 1983.*

3. L. B. Gross, "Chemical Composition of B&W Fabricated Reactor Vessel Beltline Welds," BAW-2121P, B&W Nuclear Technologies, Inc., Lynchburg, Virginia, April 1991.

* This report is available from B&W Nuclear Technologies, Inc., Lynchburg, Virginia.

5.0 CERTIFICATION

This report accurately responds to the information requested in Generic Letter 92-01, Revision 1, Supplement 1.

M J DeVan 10/31/95

M. J. DeVan, Engineer III — Date

Materials & Structural Analysis Unit

This report has been reviewed for technical content and accuracy.

L B Gross OCT. 31, 1995

L. B. Gross, Advisory Engineer — Date

Materials & Structural Analysis Unit

Verification of independent review.

K. E. Moore 10-31-95

K. E. Moore, Manager — Date

Materials & Structural Analysis Unit

This report is approved for release.

D L Howell 10/31/95

D. L. Howell — Date

Program Manager

APPENDIX A

DOCUMENT SUMMARY

Perrin, J.S., et al., "Final Report on Point Beach Nuclear Plant Unit No. 1 Pressure Vessel Surveillance Program: Evaluation of Capsule V," BMI-0673, Battelle Columbus Laboratories, Columbus, Ohio, June 15, 1973.

Perrin, J.S., et al., "Final Report on Point Beach Nuclear Plant Unit No. 2 Pressure Vessel Surveillance Program: Evaluation of Capsule V," BMI-0675, Battelle Columbus Laboratories, Columbus, Ohio, June 10, 1975.

Perrin, J.S., et al., "Surry Unit No. 1 Pressure Vessel Irradiation Capsule Program: Examination and Analysis of Capsule T," Battelle Columbus Laboratories, Columbus, Ohio, June 24, 1975.

Lowe, A.L., Jr., et al., "Analysis of Capsule OC1-F from Duke Power Company Oconee Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1421, Rev. 1, Babcock & Wilcox, Lynchburg, Virginia, September 1975.*

Lowe, A.L., Jr., et al., "Analysis of Capsule OC1-E Duke Power Company Oconee Nuclear Station - Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1436, Babcock & Wilcox, Lynchburg, Virginia, September 1977.*

Lowe, A.L., Jr., et al., "Analysis of Capsule OCII-C from Duke Power Company Oconee Nuclear Station, Unit 2 Reactor Vessel Material Surveillance Program," BAW-1437, Babcock & Wilcox, Lynchburg, Virginia, May 1977.*

Lowe, A.L., Jr., et al., "Analysis of Capsule OCIII-A from Duke Power Company Oconee Nuclear Station, Unit 3 Reactor Vessel Materials Surveillance Program," BAW-1438, Babcock & Wilcox, Lynchburg, Virginia, July 1977.*

Lowe, A.L., Jr., et al., "Analysis of Capsule TMI-1E from Metropolitan Edison Company Three Mile Island Nuclear Station-Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1439, Babcock & Wilcox, Lynchburg, Virginia, January 1977.*

Lowe, A.L., Jr., et al., "Analysis of Capsule ANI-E from Arkansas Power & Light Company Arkansas Nuclear One -- Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1440, Babcock & Wilcox, Lynchburg, Virginia, April 1977.*

Moore, K.E., and A.S. Heller, "Chemistry of 177-FA B&W Owners' Group Reactor Vessel Beltline Welds," BAW-1500, Babcock & Wilcox, Lynchburg, Virginia, September 1978.*

Harbison, L. S., "Master Integrated Reactor Vessel Surveillance Program," BAW-1543, Revision 4, B&W Nuclear Technologies, Inc., Lynchburg, Virginia, February 1993.

* This report is available from B&W Nuclear Technologies, Inc., Lynchburg, Virginia.

Lowe, A.L., Jr., et al., "Analysis of Capsule CR3-B Florida Power Corporation Crystal River Unit 3 Reactor Vessel Materials Surveillance Program," BAW-1679, Rev. 1, Babcock & Wilcox, Lynchburg, Virginia, June 1982.*

Lowe, A.L., Jr., et al., "Analysis of Capsule OCIII-B from Duke Power Company Oconee Nuclear Station, Unit 3 Reactor Vessel Materials Surveillance Program," BAW-1697, Babcock & Wilcox, Lynchburg, Virginia, October 1981.*

Lowe, A.L., Jr., et al., "Analysis of Capsule ANI-B from Arkansas Power & Light Company's Arkansas Nuclear One, Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1698, Babcock & Wilcox, Lynchburg, Virginia, November 1981.*

Lowe, A.L., Jr., et al., "Analysis of Capsule OCII-A from Duke Power Company's Oconee Nuclear Station, Unit 2 Reactor Vessel Material Surveillance Program," BAW-1699, Babcock & Wilcox, Lynchburg, Virginia, December 1981.*

Lowe, A.L., et al., "Analyses of Capsule TE1-F The Toledo Edison Company Davis-Besse Nuclear Power Station Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1701, Babcock & Wilcox, Lynchburg, Virginia, January 1982.*

Lowe, A.L., Jr., et al., "Analysis of Capsule RS1-B Sacramento Municipal Utility District Rancho Seco Unit 1 Reactor Vessel Material Surveillance Program," BAW-1702, Babcock & Wilcox, Lynchburg, Virginia, February 1982.*

Lowe, A.L., Jr., et al., "Analysis of Capsule RS1-D Sacramento Municipal Utility District Rancho Seco Unit 1 Reactor Vessel Material Surveillance Program," BAW-1792, Babcock & Wilcox, Lynchburg, Virginia, October 1983.*

Lowe, A.L., Jr., and J.W. Pegram, "Correlations for Predicting the Effects of Neutron Radiation on Linde 80 Submerged-Arc Welds," BAW-1803, Rev. 1, B&W Nuclear Service Company, Lynchburg, Virginia, May 1991.*

Aadland, J.D., "Babcock & Wilcox Owners' Group 177-Fuel Assembly Reactor Vessel and Surveillance Program Materials Information," BAW-1820, Babcock & Wilcox, Lynchburg, Virginia, December 1984.*

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* This report is available from B&W Nuclear Technologies, Inc., Lynchburg, Virginia.

Lowe, A.L., Jr., et al., "Analysis of Capsule ANI-A Arkansas Power & Light Company Arkansas Nuclear One, Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1836, Babcock & Wilcox, Lynchburg, Virginia, July 1984.*

Aadland, J.D., et al., "Analysis of Capsule OC1-A Duke Power Company Oconee Nuclear Station - Unit 1 Reactor Vessel Materials Surveillance Program," BAW-1837, Babcock & Wilcox, Lynchburg, Virginia, August 1984.*

Lowe, A.L., et al., "Analyses of Capsule TE1-A The Toledo Edison Company Davis-Besse Nuclear Power Station Unit 1 Reactor Vessel Material Surveillance Program," BAW-1882, Rev. 1, Babcock & Wilcox, Lynchburg, Virginia, June 1989.*

Lowe, A.L., Jr., et al., "Analysis of Capsule CR3-C Florida Power Corporation Crystal River Unit 3 Reactor Vessel Materials Surveillance Program," BAW-1898, Babcock & Wilcox, Lynchburg, Virginia, March 1986.*

Lowe, A.L., Jr., et al., "Analysis of Capsule CR3-D Florida Power Corporation Crystal River Unit 3 Reactor Vessel Materials Surveillance Program," BAW-1899, Babcock & Wilcox, Lynchburg, Virginia, March 1986.*

Lowe, A.L., Jr., et al., "Analysis of Capsule TMI1-C GPU Nuclear Three Mile Island Nuclear Station-Unit 1 Reactor Vessel Material Surveillance Program," BAW-1901, Babcock & Wilcox, Lynchburg, Virginia, March 1986.*

Lowe, A.L., Jr., et al., "Analysis of Capsule CR3-LG1 -- Babcock & Wilcox Owners Group Integrated Reactor Vessel Materials Surveillance Program," BAW-1910P, Babcock & Wilcox, Lynchburg, Virginia, August 1986.*

Lowe, A.L., Jr., et al., "Analysis of Capsule DB1-LG1 -- Babcock & Wilcox Owners Group Integrated Reactor Vessel Materials Surveillance Program," BAW-1920P, Babcock & Wilcox, Lynchburg, Virginia, October 1986.*

Lowe, A.L., Jr., et al., "Analysis of Capsule CR3-F Florida Power Corporation Crystal River Unit 3 Reactor Vessel Materials Surveillance Program," BAW-2049, Babcock & Wilcox, Lynchburg, Virginia, September 1988.*

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* This report is available from B&W Nuclear Technologies, Inc., Lynchburg, Virginia.

Lowe, A.L., Jr., et al., "Analysis of Capsule OCII-E Duke Power Company Oconee Nuclear Station Unit-2 Reactor Vessel Material Surveillance Program," BAW-2051, Babcock & Wilcox, Lynchburg, Virginia, October 1977.*

Lowe, A.L., Jr., et al., "Analysis of Capsule RS1-F Sacramento Municipal Utility District Rancho Seco Unit 1 Reactor Vessel Material Surveillance Program," BAW-2074, Babcock & Wilcox, Lynchburg, Virginia, April 1989.*

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Gross, L.B., "Chemical Composition of B&W Fabricated Reactor Vessel Beltline Welds," BAW-2121P, 77-2121-00, B&W Nuclear Service Company, Lynchburg, Virginia, April 1991.*

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APPENDIX B

SUPPORTING INFORMATION FOR EFFECT ON PROJECTED VALUES OF RT_{PTS} OF APPLYING RATIO PROCEDURE

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this Appendix is to provide the supporting information regarding the calculations of the chemistry factors and pressurized thermal shock reference temperature (RT_{PTS}) values contained in Table 2-1 of this report relative to the use of Regulatory Guide 1.99, Revision 2, Position 2.1[B-1] ratio procedure.

The RT_{PTS} values are calculated in accordance with the proposed revision of 10CFR50.61.[B-2] These calculations are applied to the Linde 80 beltline welds in B&W Owners Group (B&WOG) Reactor Vessel Working Group (RVWG) plants.

2.0 SUMMARY OF RESULTS

Chemistry factor and projected RT_{PTS} values by applying the Regulatory Guide 1.99, Revision 2, Position 2.1, ratio procedure are shown in Table 1.

3.0 ASSUMPTIONS

No major assumptions are contained in this calculation.

Table 1. Effect on Projected Values of RT_{PTS} of Applying Ratio Procedure of Regulatory Guide 1.99, Revision 2, Position 2.1

Plant (1)	Weld Wire (Weld Id.) (2)	Chem. Factor (3)	Ratio Chem. Factor (4)	RT_{PTS} (5)	Ratio RT_{PTS} (6)	Screening Criteria (7)
ANO-1	821T44 (WF-182-1)	162.1	170.7	156.3	164.5	300
	406L44 (WF-112)	175.0	184.5	173.0	182.4	300
CR3	71249 (SA-1769)	N/A*	N/A*	N/A*	N/A*	300
	72105 (WF-70)	138.4	136.6	132.3	130.6	300
DB	821T44 (WF-182-1)	162.1	170.7	166.2	174.9	300
REG	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
	61782 (SA-847)	147.2	152.1	198.0	204.5	300
OC1	61782 (SA-1135)	147.2	152.1	67.4	69.6	300
	71249 (SA-1229)	N/A*	N/A*	N/A*	N/A*	300
	72445 (SA-1585)	149.8	143.8	144.8	139.0	300
OC2	406L44 (WF-154)	175.0	184.5	167.6	176.6	300
	299L44 (WF-25)	216.9	231.4	212.7	226.8	300
OC3	821T44 (WF-200)	162.1	170.7	154.3	162.5	300
	72442 (WF-67)	N/A*	N/A*	N/A*	N/A*	300
PB1	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
	61782 (SA-847)	147.2	152.1	168.1	173.6	270
PB2	72442 (SA-1484)	N/A*	N/A*	N/A*	N/A*	300
S1	72445 (SA-1585)	149.8	143.8	203.8	195.7	300
	299L44 (SA-1526)	216.9	231.4	190.6	203.2	270
S2	72445 (SA-1585)	149.8	143.8	136.7	131.3	270
TMI-1	72105 (WF-70)	138.4	136.6	130.8	129.1	300
	299L44 (WF-25)	216.9	231.4	208.8	222.7	300
	299L44 (SA-1526)	216.9	231.4	201.8	215.3	270
TP3	72442 (SA-1484)	N/A*	N/A*	N/A*	N/A*	300
	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
TP4	72442 (WF-67)	N/A*	N/A*	N/A*	N/A*	300
	71249 (SA-1101)	N/A*	N/A*	N/A*	N/A*	300
Z1	406L44 (WF-154)	175.0	184.5	185.3	195.3	300
	72105 (WF-70)	191.5	227.8	221.9	263.7	300
Z2	821T44 (WF-200)	162.1	170.7	174.9	184.2	300
	72105 (WF-70)	191.5	227.8	166.0	197.2	270
	71249 (SA-1769)	N/A*	N/A*	N/A*	N/A*	300

* Surveillance data not used to calculate chemistry factor/RT_{PTS} value.

Notes to Table 1:

(1)	ANO-1	- Arkansas Nuclear One Unit 1
	CR3	- Crystal River Unit 3
	DB	- Davis-Besse
	REG	- R. E. Ginna
	OC1	- Oconee Unit 1
	OC2	- Oconee Unit 2
	OC3	- Oconee Unit 3
	PB1	- Point Beach Unit 1
	PB2	- Point Beach Unit 2
	S1	- Surry Unit 1
	S2	- Surry Unit 2
	TMI-1	- Three Mile Island Unit 1
	TP3	- Turkey Point Unit 3
	TP4	- Turkey Point Unit 4
	Z1	- Zion Unit 1
	Z2	- Zion Unit 2

(2) Weld wire heat number with weld identifications where surveillance data is available.

(3) Chemistry factor in accordance with 10CFR50.61 without using ratio procedure (see Table A-1, pages B-27 through B-29).

(4) Chemistry factor with application of Regulatory Guide 1.99, Revision 2, Position 2.1, ratio procedure (see Table B-1, pages B-31 through B-33).

(5) Predicted RT_{PTS} value in accordance with proposed 10CFR50.61, Federal Register, October 4, 1994 (see Table 7, pages B-17 and B-18).

(6) Predicted RT_{PTS} value in accordance with proposed 10CFR50.61, Federal Register, October 4, 1994 and using "ratioed chemistry factor" in accordance with Regulatory Guide 1.99, Revision 2, Position 2.1 (see Table 10, pages B-24 and B-25).

(7) Screening criteria in accordance with 10CFR50.61.

4.0 BASIS OF INPUT DATA

4.1 Linde 80 Weld Wire Chemical Compositions

4.1.1 Chemical Compositions for Reactor Vessel Beltline Welds

The best-estimate Linde 80 weld metal compositions are based on work reported in BAW-1500P[B-3] and BAW-2121P.[B-4] Table 2 presents the copper and nickel chemical compositions of the Linde 80 weld wire where surveillance data are available for reactor vessel integrity evaluations.

4.1.2 Surveillance Data Chemical Compositions

The copper and nickel chemical compositions including supplemental analyses performed on tested surveillance specimens for the each Linde 80 weld metal included in the B&W Owners Group RVWG Master Integrated Surveillance Program are shown in Table 3.

4.2 Neutron Fluence Estimates

The end-of-life (i.e., 32 EFPY) neutron fluences for the RVWG reactor vessel weld metals for which surveillance data is available are shown in Table 4. The end-of-life inside surface fluences were taken from BAW-2222[B-5] with the exception of R. E. Ginna where the end-of-life inside surface fluence was taken from WCAP-13902.[B-6]

Table 2. Best-Estimate Chemical Composition of Linde 80 Weld Wires for Which Surveillance Data is Available

Weld Wire	Weld Metal Identification	Chemical Composition, wt%	
		Cu	Ni
299L44	SA-1526, WF-25	0.35	0.68
406L44	WF-112, WF-154, WF-193	0.31	0.59
61782	SA-847, SA-848, SA-1036, SA-1135	0.25	0.54
71249	SA-1094, SA-1101, SA-1229, SA-1769	0.26	0.60
72105	WF-70, WF-209-1	0.35	0.59
72442	SA-1484, WF-67	0.24	0.60
72445	SA-1263, SA-1585, SA-1650, WF-9	0.21	0.59
821T44	WF-182-1, WF-200	0.24	0.63

Table 3. Chemical Composition of Linde 80 Surveillance Weld Metals

Weld Wire	Weld Metal Identification	Chemical Composition, wt%		Reference
		Cu	Ni	
299L44	SA-1526 - B&W Owners Group	0.37	0.70	BAW-1543, Rev. 4[B-7,B-8]
	SA-1526 - Surry-1	0.25 0.243	0.68 0.643	WCAP-11415[B-9] WCAP-11415
	WF-25 - Three Mile Island-1	0.33	0.66	BAW-1820[B-10]
	WF-25(6) - B&W Owners Group	0.35	0.67	BAW-1543, Rev. 4
	WF-25(9) - B&W Owners Group	0.35	0.70	BAW-1543, Rev. 4
406L44	WF-112 - Oconee-1	0.32	0.59	BAW-1820
	WF-112 - B&W Owners Group	0.32	0.59	BAW-1543, Rev. 4
	WF-193 - Arkansas Nuclear One-1	0.28	0.59	BAW-1820
	WF-193 - Rancho Seco-1	0.31	0.59	BAW-1820
	WF-193 - Point Beach-2	0.25	0.59	WCAP-7712[B-11]
61782	SA-1036 - R. E. Ginna	0.23 0.22	0.56 0.50	WCAP-10086[B-12] WCAP-10086
	SA-1135 - B&W Owners Group	0.27	0.59	BAW-1543, Rev. 4

Table 3 (cont'd). Chemical Composition of Linde 80 Surveillance Weld Metals

Weld Wire	Weld Metal Identification	Chemical Composition, wt%		Reference
		Cu	Ni	
71249	SA-1094 - Turkey Point-4	0.30	0.60	WCAP-7660[B-13]
	SA-1101 - Turkey Point-3	0.31	0.57	WCAP-7656[B-14]
72105	WF-70(N) - B&W Owners Group	0.42	0.59	BAW-1543, Rev. 4
	WF-209-1 - Oconee-2	0.36	0.58	BAW-1820
	WF-209-1 - Oconee-3	0.30	0.58	BAW-1820
	WF-209-1 - Zion-1	0.35	0.57	BAW-2082[B-15]
		0.216	0.53	SwRI-7484-001/1[B-16]
		0.27	0.57	SwRI-7484-001/1
		0.218	0.545	SwRI-7484-001/1
		0.25	0.49	SwRI-7484-001/1
		0.26	0.56	SwRI-7484-001/1
		0.26	0.54	SwRI-7484-001/1
		0.24	0.55	SwRI-7484-001/1
		0.26	0.53	SwRI-7484-001/1
		0.28	0.56	SwRI-7484-001/1
		0.25	0.54	SwRI-7484-001/1
		0.25	0.55	BAW-2082
		0.22	0.55	BAW-2082
		0.22	0.54	BAW-2082
		0.23	0.54	BAW-2082
		0.23	0.54	BAW-2082
		0.22	0.54	BAW-2082
		0.24	0.55	BAW-2082
		0.24	0.53	BAW-2082

Table 3 (cont'd). Chemical Composition of Linde 80 Surveillance Weld Metals

Weld Wire	Weld Metal Identification	Chemical Composition, wt%		Reference
		Cu	Ni	
72105 (cont'd)	WF-209-1 - Zion-2	0.28	0.55	WCAP-12396[B-17]
		0.19	0.52	SwRI-6901[B-18]
		0.23	0.52	SwRI-6901
		0.23	0.54	SwRI-6901
		0.25	0.53	SwRI-6901
		0.27	0.53	SwRI-6901
		0.21	0.48	SwRI-6901
		0.17	0.53	SwRI-6901
		0.26	0.54	SwRI-6901
		0.23	0.47	SwRI-6901
		0.22	0.52	SwRI-6901
		0.20	0.56	SwRI-6901
		0.26	0.53	SwRI-6901
		0.31	0.52	SwRI-6901
		0.28	0.55	SwRI-6901
		0.26	0.57	WCAP-12396
		0.27	0.60	WCAP-12396
		0.26	0.59	WCAP-12396
		0.28	0.60	WCAP-12396
		0.26	0.60	WCAP-12396
		0.27	0.60	WCAP-12396
		0.26	0.56	WCAP-12396
		0.23	0.59	WCAP-12396
72442	WF-67 - B&W Owners Group	0.22	0.60	BAW-1543, Rev. 4
72445	SA-1263 - Point Beach-1	0.24	0.57	WCAP-10736[B-19]
		0.22	0.66	WCAP-10736
	SA-1585 - B&W Owners Group	0.21	0.59	BAW-1543, Rev. 4
821T44	WF-182-1 - Davis-Besse	0.21	0.63	BAW-1820

Table 4. Predicted Inside Surface Fluence of B&WOG RVWG Reactor Vessel Weld Metals for Which Surveillance Data is Available

Plant	Weld Id.	Inside Surface Fluence, n/cm^2
Arkansas Nuclear One Unit 1	821T44 (WF-182-1) 406L44 (WF-112)	8.62E+18 9.40E+18
Crystal River Unit 3	71249 (SA-1769) 72105 (WF-70)	N/A* 8.22E+18
Davis-Besse	821T44 (WF-182-1)	1.07E+19
R. E. Ginna	71249 (SA-1101) 61782 (SA-847)	N/A* 3.68E+19
Oconee Unit 1	61782 (SA-1135) 71249 (SA-1229) 72445 (SA-1585)	1.18E+18 N/A* 8.68E+18
Oconee Unit 2	406L44 (WF-154) 299L44 (WF-25)	8.42E+18 9.19E+18
Oconee Unit 3	821T44 (WF-200) 72442 (WF-67)	8.26E+18 N/A*
Point Beach Unit 1	71249 (SA-1101) 61782 (SA-847)	N/A* 1.63E+19
Point Beach Unit 2	72442 (SA-1484)	N/A*
Surry Unit 1	72445 (SA-1585) 299L44 (SA-1526)	3.96E+19 6.39E+18
Surry Unit 2	72445 (SA-1585)	7.14E+18
Three Mile Island Unit 1	72105 (WF-70) 299L44 (WF-25) 299L44 (SA-1526)	7.89E+18 8.61E+18 7.67E+18
Turkey Point Unit 3	72442 (SA-1484) 71249 (SA-1101)	N/A* N/A*
Turkey Point Unit 4	72442 (WF-67) 71249 (SA-1101)	N/A* N/A*
Zion Unit 1	406L44 (WF-154) 72105 (WF-70)	1.21E+19 1.73E+19
Zion Unit 2	821T44 (WF-200) 72105 (WF-70) 71249 (SA-1769)	1.30E+19 6.04E+18 N/A*

* Surveillance data not used to calculate chemistry factor/RT_{PTS} value.

4.3 Initial Reference Nil-Ductility Temperature

Table 5 lists the initial reference nil-ductility temperature (IRT_{NDT}) values and their standard deviations (σ_I) for the RVWG reactor vessel beltline materials for which surveillance data is available. The IRT_{NDT} values for the Linde 80 weld metals was determined using an alternative method based on fracture toughness in the transition range. This method is described in BAW-2202[B-20] and BAW-2245, Revision 1.[B-21]

4.4 Linde 80 Weld Metal Surveillance Data Available

The available power reactor surveillance data through October 1995 for the Linde 80 weld metals are listed in Table 6. The data contained in this Table include capsule fluence and 30 ft-lb transition temperature.

5.0 PRESSURIZED THERMAL SHOCK REFERENCE TEMPERATURE

5.1 Pressurized Thermal Shock Reference Temperature, Surveillance Data Available

In accordance with proposed rule, 10CFR50.61, the pressurized thermal shock reference temperature (RT_{PTS}) is determined by the following expression:

$$RT_{PTS} = Initial\ RT_{NDT} + \Delta RT_{NDT} + Margin \qquad (1)$$

where: Initial RT_{NDT} = Initial nil-ductility reference temperature

ΔRT_{NDT} = Irradiation induced change in reference temperature

Margin = 2 sigma (σ) standard deviation

Table 5. Initial Reference Temperature for B&WOG RVWG Reactor Vessel Weld Metals for Which Surveillance Data is Available

Plant	Weld Id.	Initial RT_{NDT}, F	σ_I
Arkansas Nuclear One Unit 1	821T44 (WF-182-1)	-27	0
	406L44 (WF-112)	-27	0
Crystal River Unit 3	71249 (SA-1769)	N/A*	---
	72105 (WF-70)	-26.5	0
Davis-Besse	821T44 (WF-182-1)	-27	0
R. E. Ginna	71249 (SA-1101)	N/A*	---
	61782 (SA-847)	-27	0
Oconee Unit 1	61782 (SA-1135)	-27	0
	71249 (SA-1229)	N/A*	0
	72445 (SA-1585)	-27	0
Oconee Unit 2	406L44 (WF-154)	-27	0
	299L44 (WF-25)	-27	0
Oconee Unit 3	821T44 (WF-200)	-27	0
	72442 (WF-67)	N/A*	---
Point Beach Unit 1	71249 (SA-1101)	N/A*	---
	61782 (SA-847)	-27	0
Point Beach Unit 2	72442 (SA-1484)	N/A*	---
Surry Unit 1	72445 (SA-1585)	-27	0
	299L44 (SA-1526)	-27	0
Surry Unit 2	72445 (SA-1585)	-27	0
Three Mile Island Unit 1	72105 (WF-70)	-26.5	0
	299L44 (WF-25)	-27	0
	299L44 (SA-1526)	-27	0
Turkey Point Unit 3	72442 (SA-1484)	N/A*	---
	71249 (SA-1101)	N/A*	---
Turkey Point Unit 4	72442 (WF-67)	N/A*	---
	71249 (SA-1101)	N/A*	---
Zion Unit 1	406L44 (WF-154)	-27	0
	72105 (WF-70)	-26.5	0
Zion Unit 2	821T44 (WF-200)	-27	0
	72105 (WF-70)	-26.5	0
	71249 (SA-1769)	N/A*	---

* Surveillance data not used to calculate chemistry factor/RT_{PTS} value.

Table 6. Surveillance Data from B&W Integrated Reactor Vessel Surveillance Program

Weld Wire	Weld Metal Identification	Capsule Ident.	Fluence, n/cm^2	30 ft-lb Transition Temperature, F			Reference
				Initial	Irradiated	Delta	
299L44	SA-1526 - B&W Owners Group	TMI2-LG1	8.30E+18	9	191	182	BAW-2253P[B-22]
	SA-1526 - Surry Unit 1	T	2.81E+18	-15	150	165	WCAP-11415
		V	1.94E+19	-15	225	240	WCAP-11415
	WF-25 - Three Mile Island Unit 1	E	1.07E+18	-56	68	124	BAW-1901[B-23]
		C	8.66E+18	-56	147	203	BAW-1901
	WF-26(6) - B&W Owners Group	TMI2-LG1	9.68E+18	22	244	222	BAW-2253P
	WF-25(9) - B&W Owners Group	CR3-LG1	7.79E+18	-20	194	214	BAW-1910P[B-24]
406L44	WF-112 - Oconee Unit 1	E	1.50E+18	-5	73	78	BAW-2050[B-25]
		A	8.95E+18	-5	186	191	BAW-2050
		C	9.86E+18	-5	180	185	BAW-2050
	WF-112 - B&W Owners Group	DB1-LG1	8.21E+18	-52	152	204	BAW-1920P[B-26]
	WF-193 - Arkansas Nuclear One Unit 1	E	7.27E+17	5	110	105	BAW-2075/R1[B-27]
		A	1.03E+19	5	156	151	BAW-2075/R1
		C	1.46E+19	5	190	185	BAW-2075/R1
	WF-193 - Rancho Seco Unit 1	B	3.99E+18	-14	85	99	BAW-2074[B-28]
		D	6.60E+18	-14	138	152	BAW-2074
		F	1.42E+19	-14	152	166	BAW-2074
	WF-193 - Point Beach Unit 2	V	7.12E+18	0	165	165	BAW-2140[B-29]; WCAP-12795/R2[B-30]
		T	8.97E+18	0	150	150	BAW-2140; WCAP-12795/R2
		R	2.33E+19	0	235	235	BAW-2140; WCAP-12795/R2
		S	3.47E+19	0	231	231	BAW-2140; WCAP-12795/R2

Table 6 (cont'd). Surveillance Data from B&W Integrated Reactor Vessel Surveillance Program

Weld Wire	Weld Metal Identification	Capsule Ident.	Fluence, n/cm^2	30 ft-lb Transition Temperature, F			Reference
				Initial	Irradiated	Delta	
61782	SA-1036 - R. E. Ginna	V	5.56E+18	-25	115	140	WCAP-13902
		R	1.15E+19	-25	140	165	WCAP-13902
		T	1.97E+19	-25	125	150	WCAP-13902
		S	3.87E+19	-25	180	205	WCAP-13902
	SA-1135 - B&W Owners Group	DB1-LG1	1.03E+19	-39	103	142	BAW-1920P
71205	WF-70(N) - B&W Owners Group	TMI2-LG1	5.85E+18	45	168	123	BAW-2253P
		DB1-LG1	6.63E+18	45	180	135	BAW-1920P
		CR3-LG2	1.19E+19	45	170	125	BAW-2254P[B-31]
	WF-209-1 - Oconee Unit 2	C	1.02E+18	4	49	45	BAW-2051[B-32]
		A	3.37E+18	4	118	114	BAW-2051
		E	1.21E+19	4	183	179	BAW-2051
	WF-209-1 - Oconee Unit 3	A	8.10E+17	45	93	48	BAW-2128/R1[B-33]
		B	3.12E+18	45	109	64	BAW-2128/R1
		D	1.45E+19	45	185	140	BAW-2128/R1
	WF-209-1 - Zion Unit 1	T	2.87E+18	4	116	112	BAW-2082; WCAP-10962/R3[B-34]
		U	9.50E+18	4	203	199	BAW-2082; WCAP-10962/R3
		X	1.16E+19	4	203	199	BAW-2082; WCAP-10962/R3
		Y	1.57E+19	4	209	205	BAW-2082; WCAP-10962/R3
	WF-209-1 - Zion Unit 2	U	2.65E+18	-10	118	128	WCAP-12396; WCAP-10962/R3
		T	7.68E+18	-10	165	175	WCAP-12396; WCAP-10962/R3
		Y	1.45E+19	-10	210	220	WCAP-12396; WCAP-10962/R3

Table 6 (cont'd). Surveillance Data from B&W Integrated Reactor Vessel Surveillance Program

Weld Wire	Weld Metal Identification	Capsule Ident.	Fluence, n/cm^2	30 ft-lb Transition Temperature, F			Reference
				Initial	Irradiated	Delta	
72445	SA-1263 - Point Beach Unit 1	V	5.02E+18	-45	65	110	WCAP-10736;WCAP-12794/R2[B-35]
		S	8.29E+18	-45	120	165	WCAP-10736; WCAP-12794/R2
		R	2.38E+19	-45	120	165	WCAP-10736; WCAP-12794/R2
		T	2.42E+19	-45	135	180	WCAP-10736; WCAP-12794/R2
	SA-1585 - B&W Owners Group	CR3-LG1	5.10E+18	-27	121	148	BAW-1910P
		CR3-LG2	1.67E+18	-27	141	168	BAW-2254P
821T44	WF-182-1 - Davis-Besse	F	1.96E+18	-11	116	127	BAW-2125[B-36]
		B	5.92E+18	-11	114	125	BAW-2125
		A	1.29E+19	-11	164	175	BAW-2125
		D	9.62E+18	-11	139	150	BAW-2125

The RT_{PTS} values, where surveillance data are available, are presented in Table 7 for the B&WOG RVWG reactor vessel beltline weld materials. The results were calculated in accordance with the proposed 10CFR50.61 rule, and the calculational methods are briefly discussed below.

5.1.1 Initial Nil-Ductility Reference Temperature

The IRT_{NDT} values used to calculate the RT_{PTS} are listed in Table 5.

5.1.2 Irradiation Induced Change in Reference Temperature

The irradiation induced change in reference temperature (ΔRT_{NDT}) is defined as the mean value of the adjustment in reference temperature caused by irradiation and is calculated as follows:

$$\boxed{\Delta RT_{NDT} = (CF) \times (ff) \qquad \mathbf{(2)}}$$

where CF = Chemistry Factor

ff = Fluence Factor

5.1.2.1 Chemistry Factor

The data obtained from reactor vessel surveillance programs are used to develop a material-specific chemistry factor which is used in the calculation of ΔRT_{NDT}. The chemistry factor is calculated by multiplying each adjusted ΔRT_{NDT} value reported in the surveillance report by its corresponding fluence factor. The products of these results are then summed and divided by the sum of the squares of the fluence factors. See Attachment A for the determination of the chemistry factors using surveillance data.

Table 7. Predicted RT_{PTS} Values for the B&WOG RVWG Reactor Vessels for Which Surveillance Data is Available

Plant*	Weld Wire (Weld Identification)	Chemistry Factor	Fluence Factor	ΔRT_{NDT} (CF*ff)	IRT_{NDT}	Margin	RT_{PTS}	Screening Criteria
ANO-1	821T44 (WF-182-1) 406L44 (WF-112)	162.1 175.0	0.958 0.983	155.3 172.0	-27 -27	28 28	156.3 173.0	300 300
CR3	71249 (SA-1769) 72105 (WF-70)	N/A** 138.4	--- 0.945	--- 130.8	--- -26.5	--- 28	--- 132.3	300 300
DB	821T44 (WF-182-1)	162.1	1.019	165.2	-27	28	166.2	300
REG	71249 (SA-1101) 61782 (SA-847)	N/A** 147.2	--- 1.338	--- 197.0	--- -27	--- 28	--- 198.0	300 300
OC1	61782 (SA-1135) 71249 (SA-1229) 72445 (SA-1585)	147.2 N/A** 149.8	0.451 --- 0.960	66.4 --- 143.8	-27 --- -27	28 --- 28	67.4 --- 144.8	300 300 300
OC2	406L44 (WF-154) 299L44 (WF-25)	175.0 216.9	0.952 0.976	166.6 211.7	-27 -27	28 28	167.6 212.7	300 300
OC3	821T44 (WF-200) 72442 (WF-67)	162.1 N/A**	0.946 ---	153.3 ---	-27 ---	28 ---	154.3 ---	300 300
PB1	71249 (SA-1101) 61782 (SA-847)	N/A** 147.2	--- 1.135	--- 167.1	--- -27	--- 28	--- 168.1	300 270
PB2	72442 (SA-1484)	N/A**	---	---	---	---	---	300
S1	72445 (SA-1585) 299L44 (SA-1526)	149.8 216.9	1.354 0.874	202.8 189.6	-27 -27	28 28	203.8 190.6	300 270
S2	72445 (SA-1585)	149.8	0.906	135.7	-27	28	136.7	270

Table 7 (cont'd). Predicted RT_{PTS} Values for the B&WOG RVWG Reactor Vessels for Which Surveillance Data is Available

Plant*	Weld Wire (Weld Identification)	Chemistry Factor	Fluence Factor	ΔRT_{NDT} (CF*ff)	IRT_{NDT}	Margin	RT_{PTS}	Screening Criteria
TMI-1	72105 (WF-70)	138.4	0.934	129.3	-26.5	28	130.8	300
	299L44 (WF-25)	216.9	0.958	207.8	-27	28	208.8	300
	299L44 (SA-1526)	216.9	0.926	200.8	-27	28	201.8	270
TP3	72442 (SA-1484)	N/A**	---	---	---	---	---	300
	71249 (SA-1101)	N/A**	---	---	---	---	---	300
TP4	72442 (WF-67)	N/A**	---	---	---	---	---	300
	71249 (SA-1101)	N/A**	---	---	---	---	---	300
Z1	406L44 (WF-154)	175.0	1.053	184.3	-27	28	185.3	300
	72105 (WF-70)	191.5	1.151	220.4	-26.5	28	221.9	300
Z2	821T44 (WF-200)	162.1	1.073	173.9	-27	28	174.9	300
	72105 (WF-70)	191.5	0.859	164.5	-26.5	28	166.0	270
	71249 (SA-1769)	N/A**	---	---	---	---	---	300

* Plant Identification:

ANO-1	- Arkansas Nuclear One Unit 1	PB2	- Point Beach Unit 2
CR3	- Crystal River Unit 3	S1	- Surry Unit 1
DB	- Davis-Besse	S2	- Surry Unit 2
REG	- R. E. Ginna	TMI-1	- Three Mile Island Unit 1
OC1	- Oconee Unit 1	TP3	- Turkey Point Unit 3
OC2	- Oconee Unit 2	TP4	- Turkey Point Unit 4
OC3	- Oconee Unit 3	Z1	- Zion Unit 1
PB1	- Point Beach Unit 1	Z2	- Zion Unit 2

** Surveillance data not used to calculated chemistry factor value.

5.1.2.2 Fluence Factor

The fluence factor (ff) is determined as follows:

$$ff = f^{(0.28 - 0.10 \log f)} \tag{3}$$

where f = fluence x 10^{-19} (n/cm^2, E > 1 MeV)

5.1.3 Margin

The "margin" term is the quantity that is added to obtain conservative, upper-bound values of the PTS reference temperature for the calculations required by 10CFR50, Appendix G. The margin is determined by the following expression:

$$Margin = 2\sqrt{\sigma_I^2 + \sigma_\Delta^2} \tag{4}$$

where σ_I = standard deviation for the initial RT_{NDT}

σ_Δ = standard deviation for the ΔRT_{NDT}

If a measured value of initial RT_{NDT} for the material in question is available, σ_I is zero because the measured initial value is an absolute value and it is assumed to have no error. If generic values of initial RT_{NDT} are used, σ_I is the standard deviation obtained from the set of data used to establish the mean value.

When surveillance data is used to calculate the ΔRT_{NDT}, the σ_Δ, is 14°F for weld metals, except that σ_Δ need not exceed 0.50 times the mean value of ΔRT_{NDT}.

5.2 Regulatory Guide 1.99, Revision 2, Position 2.1, Ratio Procedure

Position 2.1 of Regulatory Guide 1.99, Revision 2, states that if there is clear evidence that the copper and nickel contents of the surveillance weld differs from that of the vessel weld, measured values of ΔRT_{NDT} should be adjusted by multiplying them by the ratio of the chemistry factor for the vessel weld to that for the surveillance weld.

To determine the ratios for adjusting the measured values of ΔRT_{NDT}, the chemistry factors for the available surveillance weld metals and the weld wire best-estimate means were calculated using 10CFR50.61, Table 1. The chemistry factors for the surveillance weld metals were calculated using the mean copper and nickel contents of the reported values listed in Table 3, while the chemistry factors for the best-estimate weld wire means were calculated using the data in Table 2. The data used to determine the ratios for the vessel weld (best-estimate mean) to that for the surveillance weld are presented in Table 8. To adjust the measured values of ΔRT_{NDT} for the available surveillance data, the measured shift in the 30 ft-lb transition temperature were multiplied by their respective chemistry factor ratio. The adjusted measured ΔRT_{NDT} are presented in Table 9, and these values are used to determine the chemistry factor in accordance with Position 2.1 of Regulatory Guide 1.99, Revision 2.

Using the available surveillance data and the ratio procedure stated in Regulatory Guide 1.99, Revision 2, Position 2.1, the RT_{PTS} values for the B&WOG RVWG reactor vessel beltline weld metals are presented in Table 10. The results were calculated in accordance with the proposed 10CFR50.61 rule, and the calculational methods are identical to those discussed in Section 5.1 with the exception of calculating the chemistry factor in which a ratio adjustment was made to the measured ΔRT_{NDT} values. See Attachment B for the determination of the chemistry factors after applying the ratio adjustment.

Table 8. Ratio of the Weld Wire Best-Estimate Mean Chemistry Factor to That of the Surveillance Weld Chemistry Factor

Weld Wire	Weld Id.	Cu	Ni	Chemistry Factor from 10CFR50.61, Table 1	Ratio (Vessel to Surv.Data)
299L44	SA-1526 (B&W Owners Group)	0.37	0.70	234.0	0.956
	SA-1526 (Surry-1)	0.25*	0.66*	185.9	1.203
	WF-25 (Three Mile Island-1)	0.33	0.66	213.7	1.046
	WF-25(6) (B&W Owners Group)	0.35	0.67	222.2	1.007
	WF-25(9) (B&W Owners Group)	0.35	0.70	226.5	0.987
	Weld Wire Heat Best-Estimate	0.35	0.68	223.6	---
406L44	WF-112 (Oconee-1)	0.32	0.59	200.6	0.980
	WF-112 (B&W Owners Group)	0.32	0.59	200.6	0.980
	WF-193 (Arkansas Nuclear One-1)	0.28	0.59	185.6	1.060
	WF-193 (Rancho Seco-1)	0.31	0.59	196.7	1.000
	WF-193 (Point Beach-2)	0.25	0.59	174.6	1.127
	Weld Wire Heat Best-Estimate	0.31	0.59	196.7	---
61782	SA-1036 (R. E. Ginna)	0.23*	0.53*	158.9	1.055
	SA-1135 (B&W Owners Group)	0.27	0.59	182.6	0.918
	Weld Wire Heat Best-Estimate	0.25	0.54	167.6	---
72105	WF-70(N) (B&W Owners Group)	0.42	0.59	229.8	0.917
	WF-209-1 (Oconee-2)	0.36	0.58	213.5	0.987
	WF-209-1 (Oconee-3)	0.30	0.58	191.3	1.102
	WF-209-1 (Zion-1)	0.28**	0.55**	180.3	1.169
	WF-209-1 (Zion-2)	0.26**	0.55**	172.8	1.220
	Weld Wire Heat Best-Estimate	0.35	0.59	210.8	---
72445	SA-1263 (Point Beach-1)	0.23*	0.62*	172.4	0.942
	SA-1585 (B&W Owners Group)	0.21	0.59	162.4	1.000
	Weld Wire Heat Best-Estimate	0.21	0.59	162.4	---
821T44	WF-182-1 (Davis-Besse)	0.21	0.63	169.0	1.053
	Weld Wire Heat Best-Estimate	0.24	0.63	178.0	---

* Mean value from data in Table 3.

** Mean value based on the mean from individual capsule chemical analyses.

Table 9. Adjustment of Measured Surveillance Data ΔRT_{NDT} Using Ratio Procedure of Regulatory Guide 1.99, Revision 2

Weld Wire Heat Number (Weld Identifications)	Cap.*	Measured ΔRT_{NDT}, F (see Table 6)	CF Ratio (See Table 8)	Normalized ΔRT_{NDT} for Weld Wire
299L44	T1	182	0.956	174.0
(SA-1526 & WF-25)	S1-T	165	1.203	198.5
	S1-V	240	1.203	288.7
	TMI-E	124	1.046	129.7
	TMI-C	203	1.046	212.3
	C1	214	0.987	211.2
	T1	222	1.007	223.6
406L44	OC1-E	78	0.980	76.4
(WF-112 & WF-193)	OC1-A	191	0.980	187.2
	OC1-C	185	0.980	181.3
	D1	204	0.980	199.9
	AN1-E	105	1.060	111.3
	AN1-A	151	1.060	160.1
	AN1-C	185	1.060	196.1
	RS1-B	99	1.000	99.0
	RS1-D	152	1.000	152.0
	RS1-F	166	1.000	166.0
	PB2-V	165	1.127	186.0
	PB2-T	150	1.127	169.1
	PB2-R	235	1.127	264.8
	PB2-S	231	1.127	260.3
61782	REG-V	140	1.055	147.7
(SA-1036 & SA-1135)	REG-R	165	1.055	174.1
	REG-T	150	1.055	158.3
	REG-S	205	1.055	216.3
	D1	142	0.918	130.4
72105 (B&W Design Only)	T1	123	0.917	112.8
(WF-70 & WF-209-1)	D1	135	0.917	123.8
	C2	125	0.917	114.6
	OC2-C	45	0.987	44.4
	OC2-A	114	0.987	112.5
	OC2-E	179	0.987	176.7
	OC3-A	48	1.102	52.9
	OC3-B	64	1.102	70.5
	OC3-D	140	1.102	154.3

Table 9 (cont'd). Adjustment of Measured Surveillance Data ΔRT_{NDT} Using Ratio Procedure of Regulatory Guide 1.99, Revision 2

Weld Wire Heat Number (Weld Identifications)	Cap.*	Measured ΔRT_{NDT}, F (see Table 6)	CF Ratio (See Table 8)	Normalized ΔRT_{NDT} for Weld Wire
72105 (W Design Only)	Z1-T	112	1.169	130.9
(WF-70 & WF-209-1)	Z1-U	199	1.169	232.6
	Z1-X	199	1.169	232.6
	Z1-Y	205	1.169	239.6
	Z2-U	128	1.220	156.2
	Z2-T	175	1.220	213.5
	Z2-Y	220	1.220	268.4
72445	PB1-V	110	0.942	103.6
(SA-1263 & SA-1585)	PB1-S	165	0.942	155.4
	PB1-R	165	0.942	155.4
	PB1-T	180	0.942	169.6
	C1	148	1.000	148.0
	C2	168	1.009	168.0
821T44	TE1-F	127	1.053	133.7
(WF-182-1)	TE1-B	125	1.053	131.6
	TE1-A	175	1.053	184.3
	TE1-D	150	1.053	158.0

* - Irradiation Capsule Identification:
T1 = B&WOG Capsule TM12-LG1
S1 = Surry Unit 1
C1 = B&WOG Capsule CR3-LG1
TMI = Three Mile Island Unit 1
AN1 = Arkansas Nuclear One Unit 1
OC1 = Oconee Unit 1
RS1 = Rancho Seco Unit 1
D1 = B&WOG Capsule DB1-LG1
PB2 = Point Beach Unit 2
REG = R. E. Ginna
OC2 = Oconee Unit 2
OC3 = Oconee Unit 3
Z1 = Zion Unit 1
Z2 = Zion Unit 2
PB1 = Point Beach Unit 1
TE1 = Davis-Besse

Table 10. Predicted RT_{PTS} Values for the B&WOG RVWG Reactor Vessels Using Ratio Procedure and Surveillance Data

Plant*	Weld Wire (Weld Identification)	Adjusted Chem. Factor	Fluence Factor	ΔRT_{NDT} (CF*ff)	IRT_{NDT}	Margin	RT_{PTS}	Screening Criteria
ANO-1	821T44 (WF-182-1)	170.7	0.958	163.5	-27	28	164.5	300
	406L44 (WF-112)	184.5	0.983	181.4	-27	28	182.4	300
CR3	71249 (SA-1769)	N/A**	---	---	---	---	---	300
	72105 (WF-70)	136.6	0.945	129.1	-26.5	28	130.6	300
DB	821T44 (WF-182-1)	170.7	1.019	173.9	-27	28	174.9	300
REG	71249 (SA-1101)	N/A**	---	---	---	---	---	300
	61782 (SA-847)	152.1	1.338	203.5	-27	28	204.5	300
OC1	61782 (SA-1135)	152.1	0.451	68.6	-27	28	69.6	300
	71249 (SA-1229)	N/A**	---	---	---	---	---	300
	72445 (SA-1585)	143.8	0.960	138.0	-27	28	139.0	300
OC2	406L44 (WF-154)	184.5	0.952	175.6	-27	28	176.6	300
	299L44 (WF-25)	231.4	0.976	225.8	-27	28	226.8	300
OC3	821T44 (WF-200)	170.7	0.946	161.5	-27	28	162.5	300
	72442 (WF-67)	N/A**	---	---	---	---	---	300
PB1	71249 (SA-1101)	N/A**	---	---	---	---	---	300
	61782 (SA-847)	152.1	1.135	172.6	-27	28	173.6	270
PB2	72442 (SA-1484)	N/A**	---	---	---	---	---	300
S1	72445 (SA-1585)	143.8	1.354	194.7	-27	28	195.7	300
	299L44 (SA-1526)	231.4	0.874	202.2	-27	28	203.2	270
S2	72445 (SA-1585)	143.8	0.906	130.3	-27	28	131.3	270

Table 10 (cont'd). Predicted RT_{PTS} Values for the B&WOG RVWG Reactor Vessels Using Ratio Procedure and Surveillance Data

Plant*	Weld Wire (Weld Identification)	Adjusted Chem. Factor	Fluence Factor	ΔRT_{NDT} (CF*ff)	IRT_{NDT}	Margin	RT_{PTS}	Screening Criteria
TMI-1	72105 (WF-70)	136.6	0.934	127.6	-26.5	28	129.1	300
	299L44 (WF-25)	231.4	0.958	221.7	-27	28	222.7	300
	299L44 (SA-1526)	231.4	0.926	214.3	-27	28	215.3	270
TP3	72442 (SA-1484)	N/A**	---	---	---	---	---	300
	71249 (SA-1101)	N/A**	---	---	---	---	---	300
TP4	72442 (WF-67)	N/A**	---	---	---	---	---	300
	71249 (SA-1101)	N/A**	---	---	---	---	---	300
Z1	406L44 (WF-154)	184.5	1.053	194.3	-27	28	195.3	300
	72105 (WF-70)	227.8	1.151	262.2	-26.5	28	263.7	300
Z2	821T44 (WF-200)	170.7	1.073	183.2	-27	28	184.2	300
	72105 (WF-70)	227.8	0.859	195.7	-26.5	28	197.2	270
	71249 (SA-1769)	N/A*	---	---	---	---	---	300

* Plant Identification:

ANO-1	- Arkansas Nuclear One Unit 1	PB2	- Point Beach Unit 2
CR3	- Crystal River Unit 3	S1	- Surry Unit 1
DB	- Davis-Besse	S2	- Surry Unit 2
REG	- R. E. Ginna	TMI-1	- Three Mile Island Unit 1
OC1	- Oconee Unit 1	TP3	- Turkey Point Unit 3
OC2	- Oconee Unit 2	TP4	- Turkey Point Unit 4
OC3	- Oconee Unit 3	Z1	- Zion Unit 1
PB1	- Point Beach Unit 1	Z2	- Zion Unit 2

** Surveillance data not used to calculated chemistry factor value.

ATTACHMENT A

Chemistry Factor Determination Using Surveillance Data

Table A-1. Calculation of Weld Metal Chemistry Factors Using Surveillance Data

Weld Wire Heat Number (Weld Identifications)	Cap.*	Fluence	ΔRT_{NDT}	ff	ΔRT_{NDT} (x) ff	ff^2
299L44 (SA-1526 & WF-25)	T1	8.30E+18	182	0.948	172.5	0.899
	S1-T	2.81E+18	165	0.653	107.7	0.426
	S1-V	1.94E+19	240	1.181	283.4	1.395
	C1	7.79E+18	214	0.930	199.0	0.865
	T1	9.68E+18	222	0.991	220.0	0.982
	TMI-E	1.07E+18	124	0.431	53.4	0.186
	TMI-C	8.66E+18	203	0.960	194.9	0.922
				SUM	1,230.9	5.675
	CF = $\Sigma(\Delta RT_{NDT}$*ff) / $\Sigma(ff^2)$ = 216.9					
406L44 (WF-112, WF-154, & WF-193)	AN1-E	7.27E+17	105	0.356	37.4	0.127
	AN1-A	1.03E+19	151	1.008	152.2	1.016
	AN1-C	1.46E+19	185	1.105	204.4	1.221
	OC1-E	1.50E+18	78	0.503	39.2	0.253
	OC1-A	8.95E+18	191	0.969	185.1	0.939
	OC1-C	9.86E+18	185	0.996	184.3	0.992
	RS1-B	3.99E+18	99	0.745	73.8	0.555
	RS1-D	6.60E+18	152	0.884	134.4	0.781
	RS1-F	1.42E+19	166	1.097	182.1	1.203
	D1	8.21E+18	204	0.945	192.8	0.893
	PB2-V	7.12E+18	165	0.905	149.3	0.819
	PB2-T	8.97E+18	150	0.970	145.5	0.941
	PB2-R	2.33E+19	235	1.229	288.8	1.510
	PB2-S	3.47E+19	231	1.325	306.1	1.756
				SUM	2,275.4	13.006
	CF = $\Sigma(\Delta RT_{NDT}$*ff) / $\Sigma(ff^2)$ = 175.0					

Weld Wire Heat Number (Weld Identifications)	Cap.*	Fluence	ΔRT_{NDT}	ff	ΔRT_{NDT} (x) ff	ff^2
61782 (SA-847, SA-848, SA-1036, SA-1135, & SA-1788)	D1	1.03E+19	142	1.008	143.1	1.016
	REG-V	5.56E+18	140	0.836	117.0	0.699
	REG-R	1.15E+19	165	1.039	171.4	1.080
	REG-T	1.97E+19	150	1.185	177.8	1.404
	REG-S	3.87E+19	205	1.349	276.5	1.820
				SUM	885.8	6.019
	$CF = \Sigma(\Delta RT_{NDT} * ff) / \Sigma(ff^2) = 147.2$					
72105 - B&W Design Only (WF-70 & WF-209-1)	OC2-C	1.02E+18	45	0.421	18.9	0.177
	OC2-A	3.37E+18	114	0.701	79.9	0.491
	OC2-E	1.21E+19	179	1.053	188.5	1.109
	OC3-A	8.10E÷17	48	0.376	18.0	0.141
	OC3-B	3.12E+18	64	0.680	43.5	0.462
	OC3-D	1.45E+19	140	1.103	154.4	1.217
	T1	5.85E+18	123	0.850	104.6	0.723
	D1	6.63E+18	135	0.885	119.5	0.783
	C2	1.19E+19	125	1.049	131.1	1.100
				SUM	858.4	6.203
	$CF = \Sigma(\Delta RT_{NDT} * ff) / \Sigma(ff^2) = 138.4$					
72105 W Design Only (WF-70 & WF-209-1)	Z1-T	2.87E+18	112	0.659	73.8	0.434
	Z1-U	9.50E+18	199	0.986	196.2	0.972
	Z1-X	1.16E+19	199	1.041	207.2	1.084
	Z1-Y	1.57E+19	205	1.125	230.6	1.266
	Z2-U	2.65E+18	128	0.639	81.8	0.408
	Z2-T	7.68E+18	175	0.926	162.1	0.857
	Z2-Y	1.45E+19	220	1.103	242.7	1.217
				SUM	1,194.4	6.238
	$CF = \Sigma(\Delta RT_{NDT} * ff) / \Sigma(ff^2) = 191.5$					

Weld Wire Heat Number (Weld Identifications)	Cap.*	Fluence	ΔRT_{NDT}	ff	ΔRT_{NDT} (x) ff	ff^2
72445 (SA-1263, SA-1585, SA-1650, & WF-9)	C1	5.10E+18	148	0.812	120.2	0.659
	C2	1.67E+19	168	1.141	191.7	1.302
	PB1-V	5.02E+18	110	0.808	88.9	0.653
	PB1-S	8.29E+18	165	0.947	156.3	0.897
	PB1-R	2.38E+19	165	1.234	203.6	1.523
	PB1-T	2.42E+19	180	1.238	222.8	1.533
				SUM	983.5	6.567
	$CF = \Sigma(\Delta RT_{NDT}*ff) / \Sigma(ff^2) = 149.8$					
821T44 (WF-182-1 & WF-200)	TE1-F	1.96E+18	127	0.565	71.8	0.319
	TE1-B	5.92E+18	125	0.853	106.6	0.728
	TE1-A	1.29E+19	175	1.071	187.4	1.147
	TE1-D	9.62E+18	150	0.989	148.4	0.978
				SUM	514.2	3.172
	$CF = \Sigma(\Delta RT_{NDT}*ff) / \Sigma(ff^2) = 162.1$					

* - Irradiation Capsule Identification:

T1 = B&WOG Capsule TM12-LG1
S1 = Surry Unit 1
C1 = B&WOG Capsule CR3-LG1
TMI = Three Mile Island Unit 1
AN1 = Arkansas Nuclear One Unit 1
OC1 = Oconee Unit 1
RS1 = Rancho Seco Unit 1
D1 = B&WOG Capsule DB1-LG1
PB2 = Point Beach Unit 2
REG = R. E. Ginna
OC2 = Oconee Unit 2
OC3 = Oconee Unit 3
Z1 = Zion Unit 1
Z2 = Zion Unit 2
PB1 = Point Beach Unit 1
TE1 = Davis-Besse

ATTACHMENT B

Chemistry Factor Determination Using Ratio Procedure and Surveillance Data in Accordance with Regulatory Guide 1.99, Revision 2, Position 2.1

Table B-1. Calculation of Weld Metal Chemistry Factors Using Ratio Procedure and Surveillance Data

Weld Wire Heat Number (Weld Identifications)	Cap.*	Fluence	Ratio Adjusted ΔRT_{NDT}	ff	ΔRT_{NDT} (x) ff	ff^2
299L44 (SA-1526 & WF-25)	T1	8.30E+18	174.0	0.948	165.0	0.899
	S1-T	2.81E+18	198.5	0.653	129.6	0.426
	S1-V	1.94E+19	288.7	1.181	341.0	1.395
	C1	7.79E+18	211.2	0.930	196.4	0.865
	T1	9.68E+18	223.6	0.991	221.6	0.982
	TMI-E	1.07E+18	129.7	0.431	55.9	0.186
	TMI-C	8.66E+18	212.3	0.960	203.8	0.922
				SUM	1,313.3	5.675
	CF = $\Sigma(\Delta RT_{NDT}$*ff) / $\Sigma(ff^2)$ = 231.4					
406L44 (WF-112, WF-154, & WF-193)	AN1-E	7.27E+17	111.3	0.356	39.6	0.127
	AN1-A	1.03E+19	160.1	1.008	161.4	1.016
	AN1-C	1.46E+19	196.1	1.105	216.7	1.221
	OC1-E	1.50E+18	76.4	0.503	38.4	0.253
	OC1-A	8.95E+18	187.2	0.969	181.4	0.939
	OC1-C	9.86E+18	181.3	0.996	180.6	0.992
	RS1-B	3.99E+18	99.0	0.745	73.8	0.555
	RS1-D	6.60E+18	152.0	0.884	134.4	0.781
	RS1-F	1.42E+19	166.0	1.097	182.1	1.203
	D1	8.21E+18	199.9	0.945	188.9	0.893
	PB2-V	7.12E+18	186.0	0.905	168.3	0.819
	PB2-T	8.97E+18	169.1	0.970	164.0	0.941
	PB2-R	2.33E+19	264.8	1.229	325.4	1.510
	PB2-S	3.47E+19	260.3	1.325	344.9	1.756
				SUM	2,399.9	13.006
	CF = $\Sigma(\Delta RT_{NDT}$*ff) / $\Sigma(ff^2)$ = 184.5					

Weld Wire Heat Number (Weld Identifications)	Cap.*	Fluence	Ratio Adjusted ΔRT_{NDT}	ff	ΔRT_{NDT} (x) ff	ff^2
61782 (SA-847, SA-848, SA-1036, SA-1135, & SA-1788)	D1	1.03E+19	130.4	1.008	131.4	1.016
	REG-V	5.56E+18	147.7	0.836	123.5	0.699
	REG-R	1.15E+19	174.1	1.039	180.9	1.080
	REG-T	1.97E+19	158.3	1.185	187.6	1.404
	REG-S	3.87E+19	216.3	1.349	291.8	1.820
				SUM	915.2	6.019
	$CF = \Sigma(\Delta RT_{NDT}*ff) / \Sigma(ff^2) = 152.1$					
72105 - B&W Design Only (WF-70 & WF-209-1)	OC2-C	1.02E+18	44.4	0.421	18.7	0.177
	OC2-A	3.37E+18	112.5	0.701	78.9	0.491
	OC2-E	1.21E+19	176.7	1.053	186.1	1.109
	OC3-A	8.10E+17	52.9	0.376	19.9	0.141
	OC3-B	3.12E+18	70.5	0.680	47.9	0.462
	OC3-D	1.45E+19	154.3	1.103	170.2	1.217
	T1	5.85E+18	112.8	0.850	95.9	0.723
	D1	6.63E+18	123.8	0.885	109.6	0.783
	C2	1.19E+19	114.6	1.049	120.2	1.100
				SUM	847.4	6.203
	$CF = \Sigma(\Delta RT_{NDT}*ff) / \Sigma(ff^2) = 136.6$					
72105 W Design Only (WF-70 & WF-209-1)	Z1-T	2.87E+18	130.9	0.659	86.3	0.434
	Z1-U	9.50E+18	232.6	0.986	229.3	0.972
	Z1-X	1.16E+19	232.6	1.041	242.1	1.084
	Z1-Y	1.57E+19	239.6	1.125	269.6	1.266
	Z2-U	2.65E+18	156.2	0.639	99.8	0.408
	Z2-T	7.68E+18	213.5	0.926	197.7	0.857
	Z2-Y	1.45E+19	268.4	1.103	296.0	1.217
				SUM	1,420.8	6.238
	$CF = \Sigma(\Delta RT_{NDT}*ff) / \Sigma(ff^2) = 227.8$					

Weld Wire Heat Number (Weld Identifications)	Cap.*	Fluence	Ratio Adjusted ΔRT_{NDT}	ff	ΔRT_{NDT} (x) ff	ff^2
72445 (SA-1263, SA-1585, SA-1650, & WF-9)	C1	5.10E+18	148.0	0.812	120.2	0.659
	C2	1.67E+19	168.0	1.141	191.7	1.302
	PB1-V	5.02E+18	103.6	0.808	83.7	0.653
	PB1-S	8.29E+18	155.4	0.947	147.2	0.897
	PB1-R	2.38E+19	155.4	1.234	191.8	1.523
	PB1-T	2.42E+19	169.6	1.238	210.0	1.533
				SUM	944.6	6.567
	CF = $\Sigma(\Delta RT_{NDT}$*ff) / $\Sigma(ff^2)$ = 143.8					
821T44 (WF-182-1 & WF-200)	TE1-F	1.96E+18	133.7	0.565	75.5	0.319
	TE1-B	5.92E+18	131.6	0.853	112.3	0.728
	TE1-A	1.29E+19	184.3	1.071	197.4	1.147
	TE1-D	9.62E+18	158.0	0.989	156.3	0.978
				SUM	541.5	3.172
	CF = $\Sigma(\Delta RT_{NDT}$*ff) / $\Sigma(ff^2)$ = 170.7					

* - Irradiation Capsule Identification:

T1 = B&WOG Capsule TM12-LG1
S1 = Surry Unit 1
C1 = B&WOG Capsule CR3-LG1
TMI = Three Mile Island Unit 1
AN1 = Arkansas Nuclear One Unit 1
OC1 = Oconee Unit 1
RS1 = Rancho Seco Unit 1
D1 = B&WOG Capsule DB1-LG1
PB2 = Point Beach Unit 2
REG = R. E. Ginna
OC2 = Oconee Unit 2
OC3 = Oconee Unit 3
Z1 = Zion Unit 1
Z2 = Zion Unit 2
PB1 = Point Beach Unit 1
TE1 = Davis-Besse

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