BAW-10179, Rev.5
December 2002

SAFETY CRITERIA AND METHODOLOGY FOR ACCEPTABLE CYCLE RELOAD ANALYSES

Framatome ANP
P. O. Box 10935
Lynchburg, VA 24506-0935

SAFETY CRITERIA AND METHODOLOGY FOR ACCEPTABLE CYCLE RELOAD ANALYSES

CONTENTS

Appendix A

Additional NRC Approved Documents

The following NRC approved topical reports were incorporated in BAW-10179P-A, Revision 1. These reports have received approval subsequent to the submittal of BAW-10179P-A and describe methodologies that replace or augment methodologies described in that report. Appendices B through G provide brief descriptions of each of the reports listed below.

1. BAW-2149-A, "Evaluation of Replacement Rods in BWFC Fuel Assemblies," B&W Fuel Company, Lynchburg, Virginia, September 1993.

2. BAW-10156-A, Rev. 1, "LYNXT Core Transient Thermal-Hydraulic Program," B&W Fuel Company, Lynchburg, Virginia, August 1993.

3. BAW-10187P-A, "Statistical Core Design for B&W-Designed 177 FA Plants," B&W Fuel Company, Lynchburg, Virginia, March 1994.

4. BAW-10184P-A, "GDTACO, Urania-Gadolinia Thermal Analysis Code," B&W Fuel Company, Lynchburg, Virginia, February 1995.

5. BAW-10183P-A, "Fuel Rod Gas Pressure Criterion (FRGPC)," B&W Fuel Company, Lynchburg, Virginia, July 1995.

6. Letter from Robert C. Jones to J. H. Taylor Concerning Fuel Rod Power History Uncertainty with TACO3, October 18, 1995.

Additional Documents Approved by NRC to be Included in Revision 2 of BAW-10179P-A

The following NRC approved documents are being incorporated in BAW-10179P, Revision 2. These documents describe methodologies that replace or augment methodologies described in the initial issue and Revision 1 of BAW-10179P-A. Appendices H through K provide brief descriptions of each of the documents listed below.

7. BAW-10084P-A, Rev. 3, Program to Determine In-Reactor Performance of BWFC Fuel Cladding Creep Collapse, B&W Fuel Company, Lynchburg, Virginia, August 1995.

8. BAW-10186P-A, Extended Burnup Evaluation, Framatome Cogema Fuels, Lynchburg, Virginia, June 1997.

9. Letter from R.C. Jones to J.H. Taylor Extending Burnup Limit for TACO3, January 11, 1996.

10. Letter from R.C. Jones to J.H. Taylor Accepting Revised Measurement Uncertainty for Control Rod Worth Calculations, January 26, 1996.

11. BAW-10199P-A, The BWU Critical Heat Flux Correlations, Framatome Cogema Fuels, Lynchburg, Virginia, August 1996.

12. Letter from David B. Matthews to J. H. Taylor, "Safety Evaluation of the Babcock & Wilcox Owners Group Submittal Relating to Assumptions in the B&W ECCS Analysis," August 20. 1997.

Additional Documents Approved by NRC to be Included in Revision 3 of BAW-10179P-A

The following NRC approved documents are being incorporated in BAW-10179P, Revision 3. These documents describe methodologies that replace or augment methodologies described in the initial issue and Revisions 1 and 2 of BAW-10179P-A. Appendices N and O provide brief descriptions of each of the documents listed below.

13. BAW-10192PA, BWNT Loss of Coolant Accident Evaluation Model for Once-Through Steam Generator Plants, June 1998.

14. BAW-10221P-A, NEMO-K A Kinetics Solution in NEMO, September 1998.

Additional Documents Approved by NRC to be Included in Revision 4 of BAW-10179P-A

The following NRC approved documents are being incorporated in BAW-10179P, Revision 4. These documents describe methodologies that replace or augment methodologies described in the initial issue and Revisions 1, 2, and 3 of BAW-10179P-A. Appendices P, Q, R, S, and T provide brief descriptions of each of the documents listed below.

15. BAW-10133P-A, Rev. 1, Addendum 1 and Addendum 2 - Addendum 1 and Addendum 2 to Mark-C Fuel Assembly LOCA-Seismic Analyses, November 2000.

16. BAW-10199P-A, Addendum 1 - The BWU Critical Heat Flux Correlations, December 2000.

17. BAW-10227P-A, Evaluation of Advanced Cladding and Structural Material (M5™) in PWR Reactor Fuel, February 2000.

18. BAW-10228P-A, SCIENCE, December 2000.

19. BAW-10229P-A, Mark-B11 Fuel Assembly Design Report, April 2000.

Additional Documents Approved by NRC to be Included in Revision 5 of BAW-10179P-A

The following NRC approved documents are being incorporated in BAW-10179P, Revision 5. These documents describe methodologies that replace or augment methodologies described in the initial issue and Revisions 1, 2, 3, and 4 of BAW-10179P-A. Appendices U and V provide brief descriptions of each of the documents listed below.

20. BAW-10164P-A, Revision 4, RELAP5/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis, November 2002.

21. BAW-10241P, BHTP DNB Correlation Applied With LYNXT (upon approval).

Appendix U

RELAP5/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis – BAW-10164P-A, Revision 4

BAW-10164P-A (reference 2) describes the RELAP5/MOD2-B&W computer code utilized in the BWNT LOCA EM topical report BAW-10192PA (reference 1), which is discussed in Appendix N. Revision 3 of topical report BAW-10164P-A is described in detail and referenced in BAW-10192PA. Subsequent to the approval of BAW-10192PA, the RELAP5/MOD2-B&W code topical report BAW-10164P-A has been revised and SERs have been issued. The SERs allow use of new models or changes with the EM described in BAW-10192PA. The topical report SERs that approve the changes made in BAW-10164P-A are listed below.

#	Description of Change to BAW-10164P-A Rev. 3	Topical Report SER
1	Changes to allow analysis of M5 cladding	BAW-10227P-A
2	Changes to the hot channel to allow hot pin and hot assembly to be modeled separately	BAW-10164P-A Revision 4
3	Changes to initial stored energy uncertainty	BAW-10164P-A Revision 4
4	Changes to the cross-flow model for SBLOCA	BAW-10164P-A Revision 4
5	Automation of BEACH blockage limitation	BAW-10164P-A Revision 4

Discussion of BAW-10227P-A (reference 3) is included in Appendix R, therefore the appropriate reference to that topical has previously been made.

References

1. BAW-10192PA, “BWNT LOCA – BWNT Loss-of-Coolant Accident Analysis for Once-Through Steam Generator Plant”, June 1998.

2. BAW-10164P-A, Rev. 4, “RELAP5/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis”, November 2002.

3. BAW-10227P-A, “Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel”, February 2000.

Appendix V

BHTP DNB Correlation Applied With LYNXT – BAW-10241P

The HTP correlation (reference 1) has been used with the XCOBRA-IIIC thermal-hydraulic computer code (reference 2) for the reload analyses of the HTP fuel designs. The incorporation of the HTP spacer grid into the Mark-B fuel design series reflects the integration of a Siemens developed spacer grid design into a Framatome developed fuel assembly design.

BAW-10241P provides the technical justification for using the HTP correlation in the LYNXT thermal-hydraulic code (reference 3). The HTP data base has been evaluated using the LYNXT code and a 95/95 CHF design limit of 1.132 has been established. Although the original HTP CHF correlation form has been retained the re-correlation has yielded changes to some of the coefficients that reflect the use of LYNXT. Since some coefficients have changed, the correlation has the distinct name of BHTP CHF correlation.

The BHTP CHF correlation is approved for use with the LYNXT code. The BHTP correlation application ranges of coolant conditions and fuel design parameters, specified in the SER, are as follows:

Variable	Minimum Value	Maximum Value
Pressure (psia)	1775	2425
Local Mass Flux ($Mlb_m/hr\text{-}ft^2$)	0.897	3.549
Inlet Enthalpy (Btu/lb_m)	383.9	644.3
Local Quality	-0.130	0.344

Parameter	Value
Fuel Rod Diameter, in	0.360 – 0.440
Fuel Rod Pitch, in	0.496 – 0.580
Axial Spacer Span, in	10.5 – 26.2
Hydraulic Diameter, in	0.4571 – 0.5334
Heated Length, ft	9.8 – 14.0

References

1. EMF-92-153(P)(A) and EMF-92-153(P)(A) Supplement 1, "HTP: Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel", March 1994.

2. XN-NF-75-21(P)(A), Revision 2, "XCOBRA-IIIC: A Computer Code to Determine the Distribution of Coolant During Steady State and Transient Operation", Exxon Nuclear Co. January 1986.

3. BAW-10156-A, Rev. 1, "LYNXT Core Transient Thermal-Hydraulic Program", August 1993.