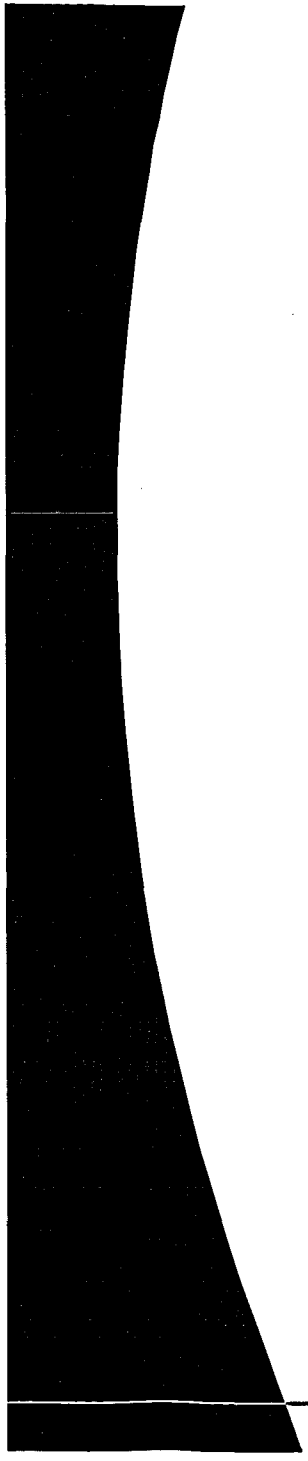

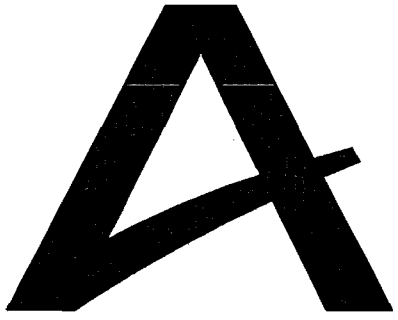

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BAW-10179P Rev. 7 OVERVIEW Safety Criteria & Methodology for Acceptable Cycle Reload Analyses

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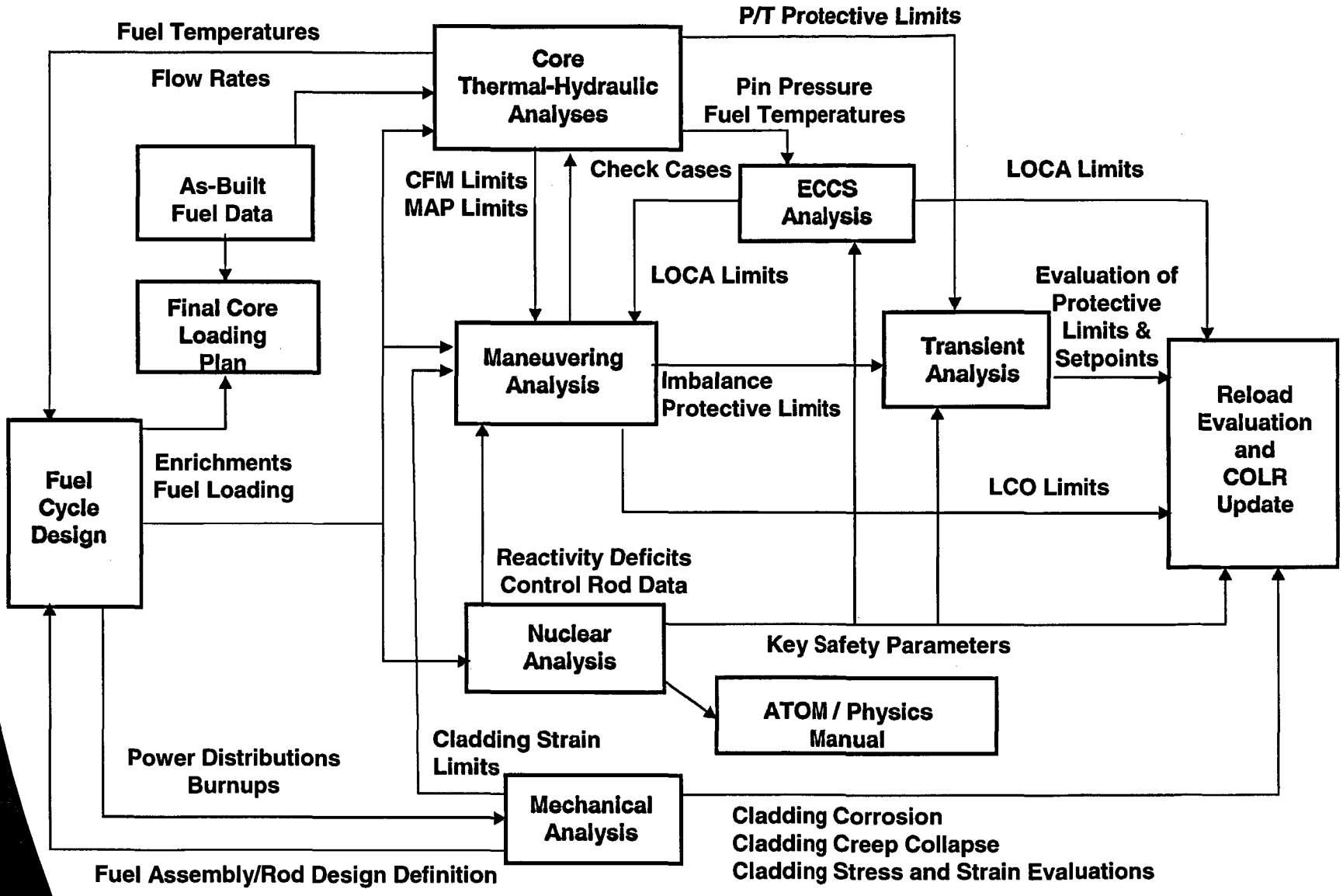
November 2, 2005

Reload Licensing Analysis Scope

- Licensing Methodology addresses Seven major analysis tasks in Four basic engineering disciplines:
  - **Mechanical Analysis**
    - Fuel Rod Mechanical and Thermal Analysis
  - **Physics (Neutronics) Analysis**
    - Fuel Cycle Design & Analysis
    - Maneuvering Analysis
    - Nuclear Analysis
  - **Thermal-Hydraulic Analysis**
    - Core Thermal-Hydraulic Performance Analysis
  - **Safety Analysis**
    - Transient (Non-LOCA) Analysis
    - ECCS (LOCA) Analysis

Reload Licensing Analysis Flow Chart



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Generic Letter 88-16
Removal of Cycle-Specific Parameter Limits from Technical Specifications

- Issued October 3, 1988
- Eliminated need for license amendments to update cycle-specific parameter limits in the Technical Specifications
- Required documenting analysis methods in NRC-approved topical report or plant-specific submittal → (hence, origin of BAW-10179)
- Provided guidance for modification of TS that contained cycle-specific parameter limits
- Definition of a named formal report containing the cycle specific parameter limits established with NRC-approved methodology (Core Operating Limits Report)
- Administrative reporting requirement to submit COLR to NRC for information

BAW-10179: Safety Criteria & Methodology Topical

- BAW-10179 is an extension of the licensing process permitted by GL 88-16
- Sponsored by *B&WOG Core Performance Committee (CPC)*
- CPC proposed extending list of COLR parameters to include the RPS Flux-ΔFlux-Flow limits and additional TS parameter limits, mainly
  - F_Q and $F_{\Delta H}$ Limits
  - EOC MTC and RBC Limits
- BAW-10179 written especially to describe the analysis methods for generation of these limits but covers entire spectrum of methodology for reloads

Current BAW-10179 Organization

- **Nine Sections of Text Descriptions (Rev 0)**
  - Describes the reload licensing analysis criteria & methods for Mark-B fuel (used in the B&W NSSS fleet)
- **Thirteen Questions & Responses (Rev 0)**
  - Inserted just before the Rev. 0 Table of Contents
- **Six Approved Revisions**
  - Each Rev adds additional approved codes or methods
- **Twenty-three Appendices**
  - Appendix A is a cumulative summary of the documents added to BAW-10179 during its successive revisions
  - Appendices B through X each describe an individual code or method added to the family of approved licensing methods

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BAW-10179 Revision 7

- Incorporates the Appendices from Revisions 1 through 6 into the main body of the report
- Updates the methodology to incorporate the NRC-approved COPERNIC design code
- Summarizes modified zero power physics testing program
- Significantly expands discussion of ECCS analysis
- Adds clarification where needed and removes unnecessary information
- Provides generic guidelines on the use of limited scope high burnup lead test assemblies (LTAs) and satisfies requirement to incorporate WCAP-15604-NP, Revision 2-A ("Limited Scope High Burnup Lead Test Assemblies") explicitly into the licensee's Technical Specifications by virtue of it being referenced in BAW-10179P-A

BAW-10179 Rev. 7 Contents

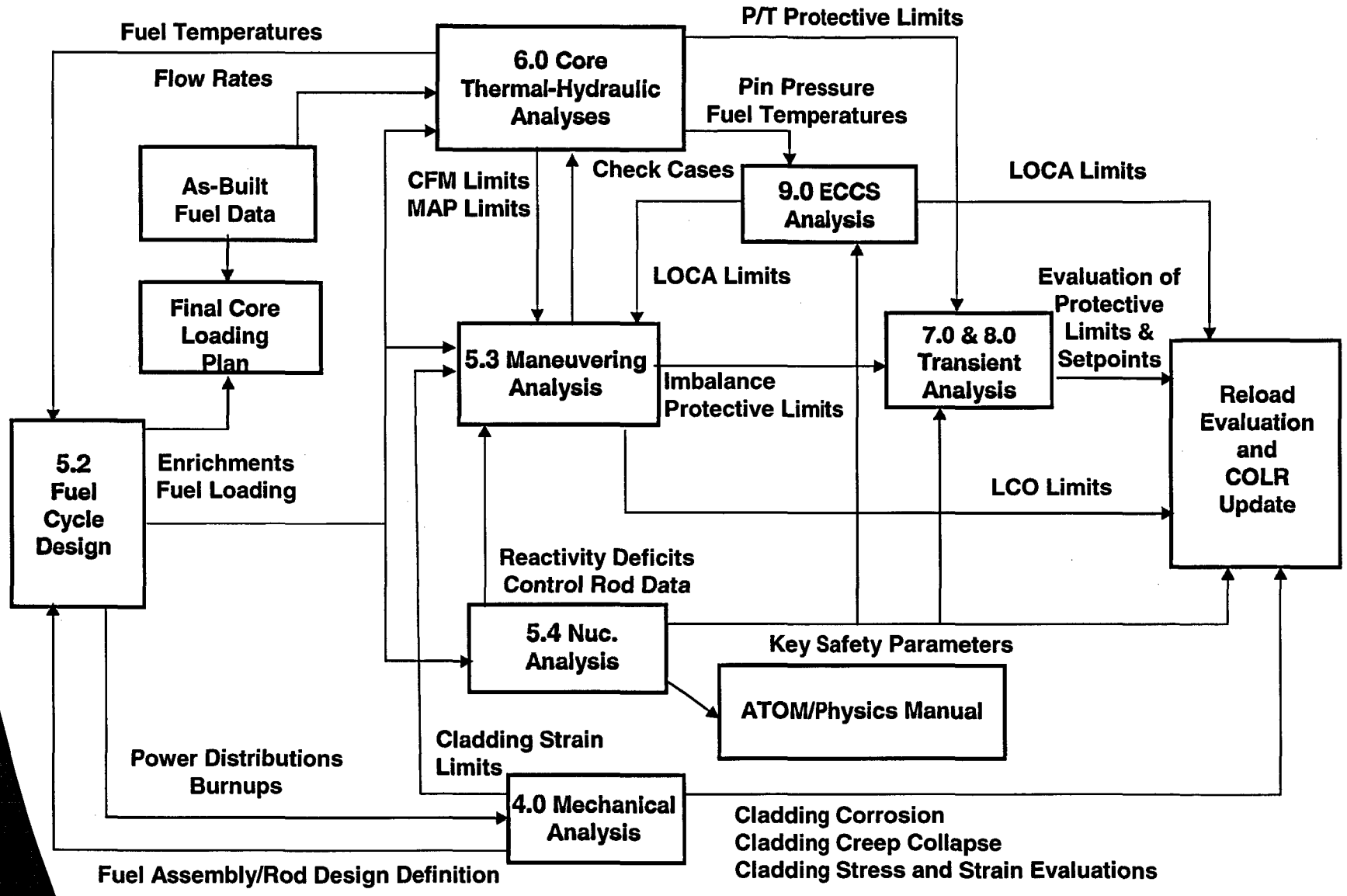
- 1.0 Introduction (purpose of the report)
- 2.0 Design Considerations (plant MODES)
- 3.0 Reference Fuel Description for Mark-B Fuel
- 4.0 Mechanical Safety & Design Criteria
- 5.0 Nuclear Design
- 6.0 Core Thermal-Hydraulics
- 7.0 Reactor Protection System Setpoints
- 8.0 Non-LOCA Accident Evaluation
- 9.0 Loss of Coolant Accident Evaluation
- 10.0 Limited Scope High Burnup Lead Test Assemblies
- 11.0 References

Location of Major Analyses in BAW-10179 Rev. 7

Mechanical Analysis	4.0
Nuclear Design Codes	5.1
Fuel Cycle Design	5.2
Power Distribution Analysis	5.3
Nuclear Parameter Analysis	5.4
Startup Physics Testing	5.5
Thermal-Hydraulic Analysis	6.0
Reactor Protection System Setpoints	7.0
Non-LOCA Accident Evaluation	8.0
Loss of Coolant Accident Evaluation	9.0
Limited Scope High Burnup LTAs	10.0

Note: Sections 4.2.8 & 4.2.9 address Fuel Rod Thermal Analysis

Reload Licensing Analysis Flow Chart



BAW-10179 Appendices – Rev. 1 (Feb. 1996)

- **Appendix B:** ***BAW-2149-A***
  - **Evaluation of Stainless Steel Replacement Rods**
- **Appendix C:** ***BAW-10156-A Rev. 1***
  - **LYNXT Core Transient Thermal-Hydraulic Program**
- **Appendix D:** ***BAW-10187P-A***
  - **Statistical Core Design for B&W-Designed 177 FA Plants**
- **Appendix E:** ***BAW-10184P-A***
  - **GDTACO, Urania-Gadolinia Thermal Analysis Code**
- **Appendix F:** ***BAW-10183P-A***
  - **Fuel Rod Gas Pressure Criterion**
- **Appendix G:** ***Letter***
  - **Fuel Rod Power History Uncertainty with TACO3**

BAW-10179 Appendices – Rev. 2 (Oct. 1997)

- **Appendix H:** ***BAW-10084P-A Rev. 3***
  - **Program to Determine Creep Collapse (CROV)**
- **Appendix I:** ***BAW-10186P-A***
  - **Extended Burnup Evaluation**
- **Appendix J:** ***Letter***
  - **Extension of Burnup Limit for TACO3**
- **Appendix K:** ***Letter***
  - **Revised Measurement Uncertainty for Rod Worth Calcs**
- **Appendix L:** ***BAW-10199P-A***
  - **The BWU Critical Heat Flux Correlations**
- **Appendix M:** ***Letter (BAW-2292P)***
  - **SER Relating to Assumptions in ECCS Analysis**

BAW-10179 Appendices – Rev. 3 (Oct. 1999)

> **Appendix N:** ***BAW-10192P-A***
  - **BWNT LOCA Evaluation Model for OTSG Plants**

> **Appendix O:** ***BAW-10221P-A***
  - **NEMO-K – Kinetics Solution in NEMO**

BAW-10179 Appendices – Rev. 4 (Aug. 2001)

- **Appendix P:** ***BAW-10133P-A Rev. 1 Add. 1& 2***
  - **Mark-C Fuel Assembly LOCA-Seismic Analyses**
- **Appendix Q:** ***BAW-10199P-A Addendum 1***
  - **The BWU Critical Heat Flux Correlations**
- **Appendix R:** ***BAW-10227P-A***
  - **Evaluation of Advanced Cladding & Structural Material**
- **Appendix S:** ***BAW-10228P-A***
  - **SCIENCE**
- **Appendix T:** ***BAW-10229P-A***
  - **Mark-B11 Fuel Assembly Design Report**

BAW-10179 Appendices – Rev. 5 (Dec. 2004)

> **Appendix U:** ***BAW-10164P-A Rev. 4***

- **RELAP5/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis**

> **Appendix V:** ***BAW-10241P-A Rev. 0***

- **BHTP DNB Correlation Applied with LYNXT**

> **Appendix W:** ***BAW-10166P-A Rev. 5***

- **BEACH – Best Estimate Analysis Core Heat Transfer, A Computer Program for Reflood Heat Transfer during LOCA**

BAW-10179 Appendices – Rev. 6 (Aug. 2005)

> Appendix X: *BAW-10241P-A Rev. 1*

- **BHTP DNB Correlation Applied with LYNXT**

Cross Reference for Location of Appendix Material in BAW-10179P Rev. 7

App	Description	Rev.7 Ref.#	Rev. 7 Section
B	BAW-2149-A SS Replacement Rod Methods	23	4.1.13, 5.2.1, 5.3.1, 5.4, 6.8, 9.3, 9.4
C	BAW-10156P-A Rev. 1 LYNXT	50	6.2.1.3 6.3.2
D	BAW-10187P-A Statistical Core Design	62	6.2.9
E	BAW-10184P-A GDTACO	28	4.2.8.2, 4.2.9.2 9.2.3
F	BAW-10183P-A - Fuel Rod Gas Pressure Criterion	31	4.2.8.2

Cross Reference for Location of Appendix Material in BAW-10179P Rev. 7

App	Description	Rev.7 Ref.#	Rev. 7 Section
G	Letter - Fuel Rod Power History Uncertainty with TACO3	30	4.2.8.2
H	BAW-10084P-A Rev. 3 - CROV: In-Reactor Creep Collapse	26	4.2.4.2
I	BAW-10186P-A Extended Burnup Evaluation	9	4.1.7.1, 4.1.7.2, 4.1.12, 4.2.3.1, 4.2.3.2, 4.2.3.3, 5.2.1.1, 9.2.3
J	Letter - Extending Burnup Limit for TACO3	29	4.2.8.2 4.2.9
K	Letter - Revised Meas. Unc. For Rod Worth Calculations	41	5.4.2.1.2 5.4.2.2.2

Cross Reference for Location of Appendix Material in BAW-10179P Rev. 7

App	Description	Rev.7 Ref.#	Rev. 7 Section
L	BAW-10199-A The BWU CHF Correlations	46	6.1
M	Letter - Assumptions in ECCS Analysis (BAW-2292)	16	4.1.9.2
N	BAW-10192P-A - BWNT LOCA EM for OTSG Plants	69	9.2 9.2.2
O	BAW-10221P-A - NEMO-K A Kinetics Solution in NEMO	34	5.1
P	BAW-10133P-A Rev. 1, Addendum 1 & Addendum 2 FA LOCA-Seismic Analysis	12	4.1.9.2

Cross Reference for Location of Appendix Material in BAW-10179P Rev. 7

App	Description	Rev.7 Ref.#	Rev. 7 Section
Q	BAW-10199-A, Addendum 1 The BWU CHF Correlations	51	6.1
R	BAW-10227P-A - Advanced Cladding & Structural Material	18	4.1.11.3, 4.2 4.2.5.1, 9.2.2, 9.3
S	BAW-10228P-A SCIENCE	--	Not included in Revision 7
T	BAW-10229P-A - Mark-B11 Fuel Assembly Design Topical	5	3.4.1
U	BAW-10164P-A Rev. 4 RELAP5/MOD2-B&W	75	9.2.2

Cross Reference for Location of Appendix Material in BAW-10179P Rev. 7

App	Description	Rev.7 Ref.#	Rev. 7 Section
V	BAW-10241P-A - BHTP Correlation Applied w/ LYNXT	4	3.3 6.1
W	BAW-10166P-A Rev. 5 BEACH	77	9.2.2
X	BAW-10241P-A Rev. 1 - BHTP Correlation Applied w/LYNXT	81	3.3 6.1

Supplementary References to Previously Approved Methodology Added in BAW-10179P Rev. 7

Description	Rev.7 Ref.#	Rev. 7 Section
Standard Review Plan, Section 4.2	8	4.1.5.2, 4.1.9.2
BAW-1847 Rev. 1: Leak-Before-Break	13	4.1.9.2
BAW-1889P: Piping Material Properties	14	4.1.9.2
BAW-1999: TMI-1 LBB Eval. Of Margins	15	4.1.9.2
Letter: Application of BAW-10186P	20	4.1.12
Letter: Application of BAW-10186P	21	4.1.12
Letter: Response to Question 13 (addresses thermal conductivity degradation with advancing burnup)	22	4.1.12
BAW-10231P-A Rev. 1: COPERNIC	25	4.2.2.2, 4.2.3.2 4.2.4.2, 4.2.8.2, 4.2.9.2
BAW-10180-A Rev. 1 NEMO	32	5.1, 5.4.2.1.2, 5.4.2.2.2

Supplementary References to Previously Approved Methodology Added in BAW-10179P Rev. 7

Description	Rev.7 Ref.#	Rev. 7 Section
Studsvik/NFA-89/3, CASMO3	33	5.1
BAW-10054 Rev. 2: Fuel Densification	37	5.3.2.4
Letter: Acceptance for Special Lic. Rpt.	38	5.3.2.4
ANSI/ANS-19.6.1-1997: PWR Phys. Tests	42	5.5.1 Table 5-2
BAW-10199P-A, Addendum 2: BWU CHF	52	6.1
BAW-10193P-A: RELAP5/MOD2-B&W for Safety Analysis of B&W PWRs	65	7.4.3
BAW-10104P-A Rev. 5: B&W ECCS EM	67	9.2.1
BAW-10154-A: B&W SB LOCA EM	68	9.2.1

Supplementary References to Previously Approved Methodology Added in BAW-10179P Rev. 7

Description	Rev.7 Ref.#	Rev. 7 Section
BAW-10092P-A Rev. 3: CRAFT2 EM	70	9.2.1
BAW-10148-A: REFLOD3	71	9.2.1
BAW-10095-A Rev. 1: CONTEMPT	72	9.2.1, 9.2.2
BAW-10094-A Rev. 3: THETA1-B	73	9.2.1
BAW-10155-A: FOAM2	74	9.2.1
BAW-10171P-A Rev. 3: REFLOD3B	76	9.2.2
WCAP-15604-NP Rev. 2-A: Hi BU LTAs	78	Abstract, Intro, 10.1, 10.3, 10.4.2
Letter: Evaluation of PSC 2-00 (Core flood line break with 2-minute operator action time)	79	9.2.2
Letter: Amendment of SER for PSC 2-00	80	9.2.2

Supplementary References to Previously Approved Methodology Added in BAW-10179P Rev. 7

Description	Rev.7 Ref.#	Rev. 7 Section
BAW-10242-A: Zero Power Physics Testing for B&W Reactors	81	5.5

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Anticipated Next Steps

- Planned submittal of BAW-10179 Revision 7 this year (2005)
- Anticipate approval of BAW-10179 in 2006

After approval of BAW-10179P-A Rev. 7:

- Process of addition of appendices restarts as new codes and methods are approved
- Latest revision of BAW-10179P-A is referenced in the individual Unit's COLR

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Summary

- BAW-10179P / BAW-10179NP has been reformatted to include references to latest approved codes and methods in the base report text, thus eliminating the appendices previously provided in the report.
- References to additional approved reports were added to clarify methodology discussions where appropriate.
- A new section 9 was prepared to expand ECCS codes & methods discussion and to separate it from the non-LOCA safety analysis discussion.
- A new section 10 was prepared to address high burnup LTAs based on the generic WCAP-15604-NP Rev. 2-A methodology.

Summary

> To facilitate review:

- Cross-reference tables are provided that point to text sections containing references to the codes, references, and letters previously provided in Appendices B through X.

- Additional tables are provided that point to text sections containing references to documents not previously referenced in BAW-10179P-A.