72-1031

NAC INTERNATIONAL

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February 9, 2006

U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Attn: Document Control Desk

Subject: Submittal of Supplemental Information for the MAGNASTOR System Application (TAC No. L23764)

Docket No. 72-1031

References:
1. MAGNASTOR System – Application for Approval, NAC International, August 31, 2004
2. Acknowledgment Review of the MAGNASTOR System Application, U.S. Nuclear Regulatory Commission (NRC), November 1, 2004
3. Request for Additional Information for the Review of the NAC MAGNASTOR System Application, NRC, May 23, 2005
4. Responses to Request for Additional Information on the NAC MAGNASTOR System Application, NAC International, September 29, 2005
5. NRC/NAC Meeting on the MAGNASTOR System RAI Responses, October 19, 2005
6. NRC/NAC Conference Call on the MAGNASTOR System RAI Responses, October 26, 2005
7. NRC/NAC Meeting on the MAGNASTOR System Thermal Analysis Methodology, December 8, 2005
8. Submittal of Supplemental Information for the MAGNASTOR System Application, NAC International, December 16, 2005
9. Revised Schedule for NAC-MAGNASTOR System Application (TAC No. L23764), NRC, January 25, 2006

NAC International, Inc. (NAC) herewith provides supplemental information related to the MAGNASTOR System application in response to discussions and questions during and subsequent to the NRC/NAC meeting on December 8, 2005 (Reference 7). This submittal includes four copies of the MAGNASTOR Safety Analysis Report (SAR), Revision 06A, changed pages. The supplemental information addresses the following areas:

- Thermal analysis and revision of VCC PWR and BWR heat loads/temperatures based on the determination of flow resistances for PWR and BWR fuel assemblies and use of the transitional turbulence model for the annulus flow, and annulus flow benchmarking for the use of low Reynold's number k-ε and k-ω turbulence modeling (affected Chapters 2, 4, 5, 12 and 13).

ED20060006

NMSS01

- Removed option for alternatives to the described neutron poison qualification testing and clarified incorporation by reference into the CoC (affected Chapters 10 and 13).
- Added Appendix 1-A, MAGNASTOR FUEL DATA, and referenced it in the Chapter 13, Technical Specifications (affected Chapters 1 and 13).
- Clarified the sequence, test requirements, equipment and acceptance criteria for the helium leakage testing of the closure lid inner vent and drain port covers (affected Chapters 9 and 10).
- Added a table in Chapter 9 to define the time limits for completion of additional vacuum drying cycles following auxiliary cooling for casks when the dryness of the canister is not achieved during the initial drying sequence.
- Performed various minor editorial changes (affected Chapters 1 and 4, and license drawing 71160-585).

Consistent with NAC administrative practice, all SAR pages changed in this submittal are uniquely identified as Revision 06A. Revision bars in the page margin mark each change on the affected page. A detailed list of the changes in the SAR is provided in Attachment 1. Changes in the chapter table of contents, list of figures, list of tables, and in text flow are not marked with revision bars. Upon final approval, the SAR will be reformatted, assigned the appropriate revision number, and issued as the NAC MAGNASTOR FSAR.

One NAC drawing has been revised in conjunction with this submittal. This drawing (71160-585, Revision 4) is included in Chapter 1 of the SAR. A detailed description of the drawing change is provided in Attachment 2.

Included in this submittal are NAC Calculation Packages 71160-3027, "Determination of Flow Resistances for PWR and BWR Fuel Assemblies," Revision 1; 71160-3029, "NEWGEN VCC/PWR Canister Thermal Evaluation with the k-ω Turbulence Model," Revision 0; 71160-3030, "NEWGEN VCC/BWR Canister Thermal Evaluation with the k-ω Turbulence Model," Revision 0; and 71660-3031, "Benchmark for the Use of Low Reynold's Number and Transitional Turbulence Model for the Annulus Flow," Revision 0, each containing one copy of the calculation and one (1) CD containing data input and output files all separately packaged and identified as proprietary information. The above calculation packages are provided to the NRC as NAC Proprietary Information. In accordance with 10 CFR 2.390, the supporting Proprietary Information Affidavit executed by Thomas A. Danner, NAC Vice President, Engineering, is enclosed.

The MAGNASTOR System is currently being considered by U.S. utilities for near-term implementation at their operating reactor sites. Therefore, NAC requests that the NRC complete the review and approval of the MAGNASTOR System in accordance with the revised schedule

as described in the NRC letter to NAC, dated January 25, 2006 (Reference 9). Any additional information requested will be promptly provided.

If you have any comments or questions, please contact me on my direct line at (678) 328-1274.

Sincerely,

Anthony L. Patko
Director, Licensing
Engineering

Enclosure, MAGNASTOR Affidavit
Attachment 1, List of SAR Changes
Attachment 2, List of Drawing Changes

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NAC INTERNATIONAL
AFFIDAVIT PURSUANT TO 10 CFR 2.390

Thomas A. Danner (Affiant), Vice President, Engineering, of NAC International, hereinafter referred to as NAC, at 3930 East Jones Bridge Road, Norcross, Georgia 30092, being duly sworn, deposes and says that:

1. Affiant has reviewed the information described in Item 2 and is personally familiar with the trade secrets and privileged information contained therein, and is authorized to request its withholding.

2. The information to be withheld includes the following NAC calculation packages that are being provided in support of the technical review of NAC's request for approval of the NAC MAGNASTOR System.

   - 71160-3027, "Determination of Flow Resistances for PWR and BWR Fuel Assemblies," Revision 1
   - 71160-3029, "NEWGEN VCC/PWR Canister Thermal Evaluation with k-ω Turbulence Model," Revision 0
   - 71160-3030, "NEWGEN VCC/BWR Canister Thermal Evaluation with k-ω Turbulence Model," Revision 0
   - 71660-3031, "Benchmark for the Use of Low Reynold's Number and Transitional Turbulence Model for the Annulus Flow," Revision 0

   The subject calculation packages include detailed analysis methods and results that have been developed by NAC and are being used for the NAC MAGNASTOR System.

   NAC is the owner of the information in the calculation packages. Thus, all of the above identified information is considered NAC Proprietary Information.

3. NAC makes this application for withholding of proprietary information based upon the exemption from disclosure set forth in: the Freedom of Information Act ("FOIA"); 5 USC Sec. 552(b)(4) and the Trade Secrets Act; 18 USC Sec. 1905; and NRC Regulations 10 CFR Part 9.17(a)(4), 2.390(a)(4), and 2.390(b)(1) for "trade secrets and commercial financial information obtained from a person, and privileged or confidential" (Exemption 4). The information for which exemption from disclosure is herein sought is all "confidential commercial information," and some portions may also qualify under the narrower definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4.

4. Examples of categories of information that fit into the definition of proprietary information are:

   a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by competitors of NAC, without license from NAC, constitutes a competitive economic advantage over other companies.

   b. Information that, if used by a competitor, would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance of quality or licensing of a similar product.

   c. Information that reveals cost or price information, production capacities, budget levels or commercial strategies of NAC, its customers, or its suppliers.

d. Information that reveals aspects of past, present or future NAC customer-funded development plans and programs of potential commercial value to NAC.

e. Information that discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information that is sought to be withheld is considered to be proprietary for the reasons set forth in Items 4.a, 4.b, and 4.d.

5. The information to be withheld is being transmitted to the NRC in confidence.

6. The information sought to be withheld, including that compiled from many sources, is of a sort customarily held in confidence by NAC, and is, in fact, so held. This information has, to the best of my knowledge and belief, consistently been held in confidence by NAC. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements, which provide for maintenance of the information in confidence. Its initial designation as proprietary information and the subsequent steps taken to prevent its unauthorized disclosure are as set forth in Items 7 and 8 following.

7. Initial approval of proprietary treatment of a document/information is made by the Vice President, Engineering, the Project Manager or the Director, Licensing – the persons most likely to know the value and sensitivity of the information in relation to industry knowledge. Access to proprietary documents within NAC is limited via "controlled distribution" to individuals on a "need to know" basis. The procedure for external release of NAC proprietary documents typically requires the approval of the Project Manager based on a review of the documents for technical content, competitive effect and accuracy of the proprietary designation. Disclosures of proprietary documents outside of NAC are limited to regulatory agencies, customers and potential customers and their agents, suppliers, licensees and contractors with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

8. NAC has invested a significant amount of time and money in the research, development, engineering and analytical costs to develop the information that is sought to be withheld as proprietary. This information is considered to be proprietary because it contains detailed descriptions of analytical approaches, methodologies, technical data and evaluation results not available elsewhere. The precise value of the expertise required to develop the proprietary information is difficult to quantify, but it is clearly substantial.

9. Public disclosure of the information to be withheld is likely to cause substantial harm to the competitive position of NAC, as the owner of the information, and reduce or eliminate the availability of profit-making opportunities. The proprietary information is part of NAC's comprehensive spent fuel storage and transport technology base, and its commercial value extends beyond the original development cost to include the development of the expertise to determine and apply the appropriate evaluation process. The value of this proprietary information and the competitive advantage that it provides to NAC would be lost if the information were disclosed to the public. Making such information available to other parties, including competitors, without their having to make similar

investments of time, labor and money would provide competitors with an unfair advantage and deprive NAC of the opportunity to seek an adequate return on its large investment.

STATE OF GEORGIA, COUNTY OF GWINNETT

Mr. Thomas A. Danner, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated herein are true and correct to the best of his knowledge, information and belief.

Executed at Norcross, Georgia, this 9th day of February 2006.

Thomas A. Danner
Vice President, Engineering
NAC International

Subscribed and sworn before me this 9th day of February, 2006.

Notary Public

NAC INTERNATIONAL

<u>**Attachment 1**</u>

List of SAR Changes for the MAGNASTOR Storage System, Revision 06A, in Response to the NRC/NAC Meeting on 12/8/05 & Subsequent NRC/NAC Conference Calls

NAC International

February 2006

List of MAGNASTOR SAR Changes, Revision 06A, in Response to theNRC/NAC Meeting on 12/8/05 & Subsequent NRC/NAC Conference Calls

Chapter/ Page/ Figure/ Table	Description of Change
Note: The affected Chapter Table of Contents, List of Figures and List of Tables have been revised accordingly to reflect the list of changes detailed below.	
Chapter 1	
Page 1.8-1	Changed Drawing 71160-585 to Revision 4
Appendix 1-A, Pages A-1 thru A-3	Added Appendix 1-A, MAGNASTOR FUEL DATA, as requested by the NRC
Chapter 2	
Page 2.2-2	1st full sentence – changed "37 kW" to "35.5 kW"; 3rd full sentence – changed "1 kW/ assembly" to "0.96 kW/assembly"
Page 2.2-3	1st full sentence – changed "35.0 kW (average of 0.402 kW/assembly)" to "33.0 kW (average of 0.379 kW/assembly)"
Page 2.2-4, Figure 2.2-1	Information beneath figure – revised Heat Load column
Page 2.2-6, Table 2.2-1	Changed the Max Decay Heat (Watts) per Storage Location from "1,300" to "1,200" & added "Preferential"; added new last bullet beneath table
Page 2.2-7 Table 2.2-2	Changed the Max Decay Heat (Watts) per Storage Location from "402" to "379"
Chapter 4	
Page 4.1-1	Section 4.1, last paragraph, 1st sentence – changed "37 kW" to "35.5 kW"; 2nd sentence – changed "1 kW per assembly" to "959 W per assembly"
Page 4.1-2	1st partial paragraph, last sentence – changed "35 kW, or 402 watts," to "33 kW, or 379 watts"
Page 4.1-4, Figure 4.1-1	Information beneath figure – revised Maximum Heat Load per Assembly (kW) line
Page 4.1-5, Table 4.1-1	Revised Environmental Temperature (°F) column
Page 4.4-4	Modeling of the Concrete Cask, 2nd paragraph, 2nd sentence – revised throughout; 8th sentence – changed "a fully turbulent model (k-ε)" to "a low Reynold's number turbulence model (low Re k-ε)" Editorial changes: 8th sentence – changed "two turbulence flow models" to "two turbulent flow models"; changed "transitional turbulent model" to "transitional turbulence model"
Page 4.4-5	1st partial paragraph, 1st partial sentence – added "low Reynold's number"; deleted 1st complete sentence (i.e., "It is observed ... k-ω model."); new 1st complete sentence – changed "k-ε model" to "k-ω model" in 2 places; last sentence – changed "k-ε turbulent model" to "k-ω turbulence model" Old 1st & 2nd full paragraphs – combined & revised throughout
Page 4.4-9	Heat Generation, 1st paragraph, last sentence – changed "37 kW and 35 kW" to "35.5 kW and 33 kW"; 2nd paragraph, 2nd sentence – changed "37 kW or 1.0 kW" to "35.5 kW or 959 W"; 4th sentence – changed "37 kW" to "35.5 kW"

Chapter/ Page/ Figure/ Table	Description of Change
Page 4.4-10	1st full paragraph, 2nd sentence – changed "35 kW" to "33 kW" & "402 watts" to "379 watts"; 5th sentence – changed "402 watts" to "379 watts"; 7th sentence – changed "402 watts" to "379 watts" Pressure of the Helium Backfill, 5th sentence – deleted "0.047 lbm/ft^3"; changed "(0.760g/liter)" to "(0.763g/liter)"
Page 4.4-11	1st partial paragraph, last sentence – changed "under 700°F" to "under 752°F (400°C)" Mesh Sensitivity Evaluation, 3rd paragraph, deleted 2nd sentence; new 2nd sentence – changed "to be between 20 and 30" to "to be less than unity"
Page 4.4-12	1st paragraph, 7th sentence – changed "37 kW" to "35.5 kW"
Page 4.4-18	Evaluation of the Water Phase, 1st paragraph, 4th sentence – changed "37 kW" to "40 kW, which bounds the design basis heat load of 35.5 kW"
Page 4.4-19	4th bullet – revised throughout
Page 4.4-20	4th bullet – revised throughout
Page 4.4-21	1st partial paragraph, 2nd full sentence – changed "1.0 kW" to "959 W"; 3rd sentence – changed "(1.0 kW/ 0.40 kW > 2)" to "(922 W/ 379 W > 2)"
Page 4.4-24	2nd full paragraph, last sentence – revised throughout
Page 4.4-30, Figure 4.4-2	Inserted revised figure
Page 4.4-33, Figure 4.4-5	Inserted revised figure
Page 4.4-42, Figure 4.4-14	Inserted revised figure
Page 4.4-43, Figure 4.4-15	Revised figure title & inserted revised figure
Page 4.4-47, Table 4.4-3	Table revised throughout
Page 4.4-47, Table 4.4-5	Table revised throughout
Page 4.5-1	Section 4.5, 2nd paragraph, last sentence – changed "37 kW and 35 kW" to "35.5 kW and 33 kW"; both tables following the 3rd paragraph revised throughout
Page 4.5-2	Off-Normal Event TSC Internal Pressure, 2nd sentence – changed "485°F" to "491°F"
Page 4.6-1	Section 4.6.1 – table revised throughout
Page 4.7-2	Added references 23 & 24
Page 4.8.2-2	Paragraph below 1st equation, 2nd sentence – changed "99,000 cells" to "199,000 cells"; 3rd sentence – revised throughout; 5th & 6th sentences – revised throughout Paragraph below 2nd equation, 4th sentence – changed "263,000 cells" to "332,500 cells"; 5th sentence – changed "8.76 inches" to "9.37 inches" in 2 places; changed "4.38 inches" to "9.37 inches"; added new 7th sentence (i.e., "The bounding ... PWR assemblies.")
Page 4.8.2-3	Paragraph below 1st equation – added new 1st sentence (i.e., "The pressure drop ... set to zero."); 2nd sentence – changed "eight grids" to "all the grids" & deleted the 2nd "eight"; 2nd equation – changed "4.64e5" to "462,087"
Page 4.8.2-4	Paragraph revised throughout
Page 4.8.2-6, Figure 4.8.2-2	Inserted revised figure
Page 4.8.2-7, Figure 4.8.2-3	Inserted revised figure

Chapter/ Page/ Figure/ Table	Description of Change
Page 4.8.3-1	Section 4.8.3, 1st sentence – added "low Reynold's (low Re)"; deleted next-to-last sentence from Revision 05A; last sentence – changed "k-ε turbulent model" to "k-ω turbulence model" Section 4.8.3.1, next-to-last sentence – added "low Re"
Page 4.8.3-2	Section 4.8.3.4, 2nd paragraph, 4th sentence – changed "or a fully developed turbulent flow model (k-ε model)" to "or a low Re turbulent flow model (low Re k-ε model)" Editorial change: 2nd paragraph, 6th sentence – changed "turbulent model" to "turbulence model"
Page 4.8.3-3	1st partial paragraph, 1st partial sentence – changed "and approximately 30 for the k-ε" to "and for the low Re k-ε model"; deleted last sentence Section 4.8.3.5, 2nd paragraph, deleted 1st & 2nd sentences Temperature Specification – revised throughout (continued on next page)
Page 4.8.3-4	Temperature Specification continued – revised throughout Heat Generation – deleted last 3 sentences Buoyancy, 2nd paragraph, 2nd sentence – added "for a site elevation of 1,400 m" Section 4.8.3.7 – deleted 2nd sentence; new 3rd sentence – revised throughout
Page 4.8.3-5	1st partial paragraph, second to last sentence – changed "37 kW" to "35.5 kW" Section 4.8.3.9, 2nd sentence – changed "k-ε turbulent flow model" to "k-ω turbulent flow model"; last sentence – changed "inlet temperature" to "ambient temperature"
Page 4.8.3-6, Figure 4.8.3-1	Inserted revised figure
Page 4.8.3-8, Figure 4.8.3-3	Inserted revised figure
Page 4.8.3-9, Figure 4.8.3-4	Inserted revised figure
Chapter 5	
Page 5.1-1	Section 5.1 – added new 2nd paragraph to clarify dose rate calculations
Page 5.8.3-2	Section 5.8.3.2 – added new last paragraph
Page 5.8.4-2	Section 5.8.4.2 – added new last paragraph
Page 5.8.7-1	Section 5.8.7 – added new last paragraph
Page 5.8.9-1	Section 5.8.9/5.8.9.1 – added new sections titled "Thermal Analysis Limited Cool-Time Tables" & "PWR", respectively
Page 5.8.9-2, Table 5.8.9-1	Added new table titled "Low Burnup PWR Fuel Loading Table"
Pages 5.8.9-3 thru 5.8.9-14 Table 5.8.9-2	Added new table titled "Loading Table for PWR Fuel – 959 W/Assembly"
Pages 5.8.9-15 thru 5.8.9-26 Table 5.8.9-3	Added new table titled "Loading Table for PWR Fuel – 1,200 W/Assembly"
Pages 5.8.9-27 thru 5.8.9-38 Table 5.8.9-4	Added new table titled "Loading Table for PWR Fuel – 922 W/Assembly"
Pages 5.8.9-39 thru 5.8.9-50 Table 5.8.9-5	Added new table titled "Loading Table for PWR Fuel – 800 W/Assembly"

Chapter/ Page/ Figure/ Table	Description of Change
Page 5.8.9-51	Added new section titled "BWR"
Page 5.8.9-52, Table 5.8.9-6	Added new table titled "Low Burnup BWR Fuel Loading Table"
Pages 5.8.9-53 thru 5.8.9-64 Table 5.8.9-7	Added new table titled "Loading Table for BWR Fuel – 379 W/Assembly"
Chapter 9	
Page 9.1-1	Section 9.1, 5th paragraph, 3rd sentence – added "helium leakage rate tested"
Page 9.1-7	Step 60, 1st Note, 1st sentence – changed "If vacuum drying times greater than those defined in Table 9.1-3" to "If the dryness verification is not met within the first vacuum drying times defined in Table 9.1-3"; 2nd sentence – added "subsequent" & "cycle"; 3rd sentence – added "and cooling periods"
Page 9.1-16, Table 9.1-1 (cont'd)	Drain and Blow Down System (DBS), 1st sentence – added "and to refill the cavity and hydrostatic test the closure lid weld"; 2nd sentence – added "and hydrostatic testing" Added definition for Helium Mass Spectrometer Leak Detector (MSLD)
Page 9.1-17, Table 9.1-3	Revised table title; removed last line of table & revised new last line of table
Page 9.1-17, Table 9.1-4	Revised table title; removed last line of table & revised new last line of table
Chapter 10	
Page 10.1-6	1st paragraph – added new sentences 1-5 & new 2nd paragraph to address helium leakage testing
Page 10.1-7	Section 10.1.6 – added NOTE textbox as requested by the NRC
Page 10.1-8	1st paragraph, 2nd sentence – deleted "Neutron transmission"
Page 10.1-11	Section 10.1.6.4.1, 4th sentence – changed "Specification section, which follows" to "following sections"; deleted old 5th sentence (i.e., "The ^{10}B presence ... neutron transmission testing."); changed new 6th sentence from "is cause for rejection" to "is not acceptable"; last sentence – changed "the surface roughness shall not exceed 125 RMS" to "exposure of the core through the cladding surface of the sheet is not acceptable" Section 10.1.6.4.2, 3rd sentence – changed "Specification section, which follows" to "following sections"; deleted old 4th sentence (i.e., "The presence, ... neutron transmission testing.") Section 10.1.6.4.3, 3rd sentence – changed "Specification section, which follows" to "following sections"; deleted old 4th sentence (i.e., "The presence, ... neutron transmission testing.")
Page 10.1-13	Section 10.1.6.4.5 – added NOTE textbox as requested by the NRC Deleted old 2nd paragraph, including 2 bullets (i.e., "Proposed alternatives ... with 10 CFR 72.") New 2nd paragraph – added new 3rd bullet
Page 10.1-14	2nd full bullet, 4th sentence – changed "(i.e., boron carbide powder, aluminum powder, or aluminum extrusion)" to "(i.e., boron carbide powder or aluminum powder)"
Page 10.1-15	1st full bullet – deleted last sentence (i.e., "Any lot of material ... shall be used.") Added new 2nd bullet; added new 4th bullet Section 10.1.6.4.6 – added NOTE textbox as requested by the NRC
Page 10.1-16	Deleted old 2nd paragraph, including 2 bullets (i.e., "Proposed alternatives ... with 10 CFR 72.")
Page 10.1-17	Added new 6th bullet

Chapter/ Page/ Figure/ Table	Description of Change

Chapter 11	
Page 11.3-2	1st paragraph – added new last sentence
Chapter 12	
Page 12.1-3	Section 12.1.2.3, table following 2nd paragraph – revised throughout Partial Section 12.1.2.5, 2nd sentence – added "a conservative 37 kW payload of"
Page 12.1-4	2nd full sentence – added "a conservative 35 kW payload of"
Page 12.2-20	Section 12.2.13.5, 3rd sentence – added "for a 37 kW payload"
Chapter 13	
Page 13A-14	Item 2.1 – changed "Tables 6.4-1 and 6.4-2" to "Appendix 1-A" Item 2.1.1 – added new item number; moved text from Item 2.3 to Item 2.1.1; changed "Number of Water Holes (PWR)" to "Number of Guide Tubes (PWR)"; added "Number of Partial Length Fuel Rods" Item 2.1.2 – added new item number & text
Page 13A-15	Item 2.2 – changed item title & revised text throughout Deleted Item 2.3 became Item 2.1.1
Page 13A-20, Table 3-1	Revised Helium Density (g/liter) column
Page 13A-24	Item 4.1.1 b), 1st sentence – changed "Section 10.1.6" to "Section 10.1.6.4.5 and Section 10.1.6.4.6"; added new 2nd sentence Old Item 4.1.2 deleted
Page 13B-2, Table 2-1	Item I.A.1.b. – changed "minimum cool time of 4 years is specified" to "minimum cool time is specified in Table 2-11" Item I.A.1.c. – changed "≤ 1,300 watts" to "≤ 1,200 watts"
Page 13B-3, Table 2-1 (cont'd)	Item F, 1st sentence – changed "1,000 watts/assembly" to "959 watts/assembly"
Page 13B-4, Table 2-2	Changed the Max Decay Heat (Watts) per Storage Location from "1,300" to "1,200"; & added "Preferential"; added new last bullet beneath table
Page 13B-5, Table 2-4	WE 14×14 line – revised
Page 13B-6, Table 2-7	Inner Zone & Middle Zone lines – revised
Page 13B-8, Table 2-8	Item I.A.1.b. – changed "minimum cool time of 4 years is specified" to "minimum cool time is specified in Table 2-12" Item I.A.1.c. – changed "≤ 402 watts" to "≤ 379 watts"
Page 13B-9, Table 2-9	Changed the Max Decay Heat (Watts) per Storage Location from "402" to "379"
Page 13B-12, Tables 2-11 & 2-12	Revised throughout
Pages 13B-13 thru 13B-24 Table 2-13	Changed table heading from "1,300 W/assembly" to "959 W/Assembly" & revised table throughout

Chapter/ Page/ Figure/ Table	Description of Change
Pages 13B-25 thru 13B-36 Table 2-14	Changed table heading from "1,000 W/Assembly" to "1,200 W/Assembly" & revised table throughout
Pages 13B-37 thru 13B-48 Table 2-15	Changed table heading from "960 W/Assembly" to "922 W/Assembly" & revised table throughout
Pages 13B-61 thru 13B-72 Table 2-17	Changed table heading from "402 W/assembly" to "379 W/Assembly" & revised table throughout

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Attachment 2

List of Drawing Changes

for

the MAGNASTOR Storage System, Revision 06A

NAC International

February 2006

Drawing 71160-585, Revision 4 – TSC Assembly, MAGNASTOR

- Revised Assemblies 99 and 98 on title sheet 2, zone B3: IS) TSC Assembly – 37 PWR; WAS) Assembly – 32 PWR

  This is an editorial change to correct the number of fuel assemblies held within the TSC.

February 2006

Revision 06A

MAGNASTOR

(Modular Advanced Generation Nuclear All-purpose STORage)

SAFETY ANALYSIS REPORT

Docket No. 72-1031

NAC INTERNATIONAL

Atlanta Corporate Headquarters: 3930 East Jones Bridge Road, Norcross, Georgia 30092 USA
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Chapter 1

Chapter 1
General Description

Table of Contents

List of Figures

List of Tables

1.8 License Drawings

This section presents the list of License Drawings for MAGNASTOR.

Drawing Number	Title	Revision No.
71160-551	Fuel Tube Assembly, MAGNASTOR – 37 PWR	3
71160-560	Assembly, Standard Transfer Cask, MAGNASTOR	1
71160-561	Structure, Weldment, Concrete Cask, MAGNASTOR	3
71160-562	Reinforcing Bar and Concrete Placement, Concrete Cask, MAGNASTOR	2
71160-571	Details, Neutron Absorber, Retainer, MAGNASTOR – 37 PWR	2
71160-572	Details, Neutron Absorber, Retainer, MAGNASTOR – 87 BWR	2
71160-574	Basket Support Weldments, MAGNASTOR – 37 PWR	2
71160-575	Basket Assembly, MAGNASTOR – 37 PWR	4
71160-581	Shell Weldment, Canister, MAGNASTOR	2
71160-584	Details, Canister, MAGNASTOR	2
71160-585	TSC Assembly, MAGNASTOR	4
71160-590	Loaded Concrete Cask, MAGNASTOR	3
71160-591	Fuel Tube Assembly, MAGNASTOR – 87 BWR	3
71160-598	Basket Support Weldments, MAGNASTOR – 87 BWR	3
71160-599	Basket Assembly, MAGNASTOR – 87 BWR	3
71160-600	Basket Assembly, MAGNASTOR – 82 BWR	1

Figure Withheld Under 10 CFR 2.390

NAC INTERNATIONAL

TSC ASSEMBLY,
MAGNASTOR

A

PROJECT 71160		DRAWING 585	REV 4
		SH 2 OF 2	

1

Figure Withheld Under 10 CFR 2.390

DRAWING No.	DESCRIPTION
1160-575-98	
1160-575-99	

NAC INTERNATIONAL

TSC ASSEMBLY,
MAGNASTOR

A

PROJECT	DRAWING	REV
71160	585	4
	SH 1 OF 2	

1

Appendix 1-A

MAGNASTOR FUEL DATA

The following tables show the PWR fuel basket allowable loadings and the BWR fuel basket allowable loadings for the MAGNASTOR System.

Table 1-A-1 covers the types of assemblies and their characteristics, along with the maximum initial enrichments, for the PWR 37-assembly fuel basket. The allowable loadings represent the bounding values for assemblies with, and without, nonfuel hardware in the assembly guide tubes.

Table 1-A-2 covers the types of assemblies and their characteristics, along with the maximum initial enrichments, for the BWR 87-assembly and 82-assembly fuel baskets.

Table 1-A-1 PWR Fuel Basket Allowable Loading

Assembly Type	No. of Fuel Rods	No. of Guide Tubes[a]	Max Pitch (inch)	Min Clad OD (inch)	Min Clad Thick. (inch)	Max Pellet OD (inch)	Max Active Length (inch)	Max Load (MTU)	Max. Initial Enrichment (wt % ^{235}U) Soluble Boron 1500 ppm	Soluble Boron 1750 ppm	Soluble Boron 2000 ppm	Soluble Boron 2250 pm	Soluble Boron 2500 ppm
BW15H1	208	17	0.568	0.43	0.0265	0.3686	144.0	0.4858	3.8%	4.1%	4.4%	4.7%	5.0%
BW15H2	208	17	0.568	0.43	0.025	0.3735	144.0	0.4988	3.7%	4.1%	4.4%	4.7%	5.0%
BW15H3	208	17	0.568	0.428	0.023	0.3742	144.0	0.5006	3.7%	4.0%	4.3%	4.7%	4.9%
BW15H4	208	17	0.568	0.414	0.022	0.3622	144.0	0.4690	3.9%	4.2%	4.6%	4.9%	5.0%
BW17H1	264	25	0.502	0.377	0.022	0.3252	144.0	0.4799	3.8%	4.1%	4.4%	4.7%	5.0%
CE14H1	176	5	0.58	0.44	0.026	0.3805	137.0	0.4167	4.6%	4.9%	5.0%	5.0%	5.0%
CE16H1	236	5	0.5063	0.382	0.025	0.325	150.0	0.4463	4.5%	4.9%	5.0%	5.0%	5.0%
WE14H1	179	17	0.556	0.40	0.0162	0.3674	145.2	0.4188	4.7%	5.0%	5.0%	5.0%	5.0%
WE15H1	204	21	0.563	0.422	0.0242	0.3669	144.0	0.4720	3.9%	4.2%	4.6%	4.9%	5.0%
WE15H2	204	21	0.563	0.417	0.0265	0.357	144.0	0.4469	4.0%	4.4%	4.8%	5.0%	5.0%
WE17H1	264	25	0.496	0.372	0.0205	0.3232	144.0	0.4740	3.8%	4.1%	4.5%	4.8%	5.0%
WE17H2	264	25	0.496	0.36	0.0225	0.3088	144.0	0.4327	4.0%	4.4%	4.8%	5.0%	5.0%

- Assembly characteristics represent cold, unirradiated, nominal configurations.
- Specified soluble boron concentrations are independent of whether a fuel assembly contains a nonfuel insert.

[a] Combined number of guide and instrument tubes.

Table 1-A-2 BWR Fuel Basket Allowable Loading

Assembly Type	Number of Fuel Rods	Number of Partial Length Rods	Max Pitch (inch)	Min Clad OD (inch)	Min Clad Thick. (inch)	Max Pellet OD (inch)	Max Active Length (inch)	Max Loading (MTU)	87-Assy Max Enrichment (wt % ^{235}U)	82-Assy Max Enrichment (wt % ^{235}U)
B7_48A	48	N/A	0.7380	0.5700	0.03600	0.4900	144.0	0.1981	4.1%	4.5%
B7_49A	49	N/A	0.7380	0.5630	0.03200	0.4880	146.0	0.2034	3.9%	4.5%
B7_49B	49	N/A	0.7380	0.5630	0.03200	0.4910	150.0	0.2115	3.9%	4.5%
B8_59A	59	N/A	0.6400	0.4930	0.03400	0.4160	150.0	0.1828	4.0%	4.5%
B8_60A	60	N/A	0.6417	0.4840	0.03150	0.4110	150.0	0.1815	3.9%	4.5%
B8_60B	60	N/A	0.6400	0.4830	0.03000	0.4140	150.0	0.1841	3.9%	4.5%
B8_61B	61	N/A	0.6400	0.4830	0.03000	0.4140	150.0	0.1872	3.9%	4.5%
B8_62A	62	N/A	0.6417	0.4830	0.02900	0.4160	150.0	0.1921	3.9%	4.5%
B8_63A	63	N/A	0.6420	0.4840	0.02725	0.4195	150.0	0.1985	3.8%	4.5%
B8_64A	64	N/A	0.6420	0.4840	0.02725	0.4195	150.0	0.2017	3.9%	4.5%
B8_64B[a]	64	N/A	0.6090	0.4576	0.02900	0.3913	150.0	0.1755	3.7%	4.4%
B9_72A	72	N/A	0.5720	0.4330	0.02600	0.3740	150.0	0.1803	3.8%	4.5%
B9_74A	74[b]	8	0.5720	0.4240	0.02390	0.3760	150.0	0.1873	3.7%	4.4%
B9_76A	76	N/A	0.5720	0.4170	0.02090	0.3750	150.0	0.1914	3.6%	4.3%
B9_79A	79	N/A	0.5720	0.4240	0.02390	0.3760	150.0	0.2000	3.7%	4.5%
B9_80A	80	N/A	0.5720	0.4230	0.02950	0.3565	150.0	0.1821	3.9%	4.5%
B10_91A	91[b]	8	0.5100	0.3957	0.02385	0.3420	150.0	0.1906	3.8%	4.5%
B10_92A	92[b]	14	0.5100	0.4040	0.02600	0.3455	150.0	0.1966	3.8%	4.5%
B10_96A[a]	96[b]	12	0.4880	0.3780	0.02430	0.3224	150.0	0.1787	3.7%	4.4%
B10_100A[a]	100	N/A	0.4880	0.3780	0.02430	0.3224	150.0	0.1861	3.7%	4.5%

Note:

- Assembly characteristics represent cold, unirradiated, nominal configurations.
- Maximum channel thickness allowed is 120 mils (nominal).

[a] Composed of four subchannel clusters.

[b] Assemblies may contain partial length fuel rods. Partial length rod assemblies are evaluated by removing partial length rods from the lattice. This configuration bounds an assembly with full length rods and combinations of full and partial length rods.

Chapter 2

2.2 Spent Fuel To Be Stored

MAGNASTOR is designed to safely store up to 37 PWR or up to 87 BWR spent fuel assemblies, contained within a TSC. The fuel assemblies are assigned to two groups of PWR and two groups of BWR fuel assemblies on the basis of fuel assembly length. Refer to Chapter 1 for the fuel assembly length groupings. For TSC spent fuel content loads less than a full basket, empty fuel positions shall include an empty fuel cell insert.

Intact PWR and BWR fuel assemblies having parameters as shown in Table 2.2-1 and Table 2.2-2, respectively, may be stored in MAGNASTOR.

The minimum initial enrichment limits are shown in Table 2.2-1 and Table 2.2-2 for PWR and BWR fuel, respectively, and exclude the loading of fuel assemblies enriched to less than 1.3 wt% ^{235}U, including unenriched fuel assemblies. Fuel assemblies with unenriched axial end-blankets may be loaded into MAGNASTOR.

2.2.1 PWR Fuel Evaluation

MAGNASTOR evaluations are based on bounding PWR fuel assembly parameters that maximize the source terms for the shielding evaluations, the reactivity for criticality evaluations, the decay heat load for the thermal evaluations, and the fuel weight for the structural evaluations. These bounding parameters are selected from the various spent fuel assemblies that are candidates for storage in MAGNASTOR. The bounding fuel assembly values are established based primarily on how the principal parameters are combined, and on the loading conditions (or restrictions) established for a group of fuel assemblies based on its parameters. Each TSC may contain up to 37 intact PWR fuel assemblies.

The limiting parameters of the PWR fuel assemblies authorized for loading in MAGNASTOR are shown in Table 2.2-1. The maximum initial enrichments listed are based on a minimum soluble boron concentration of 2,500 ppm in the spent fuel pool water. Lower soluble boron concentrations are allowed in the spent fuel pool water for fuel assemblies with lower maximum enrichments. The maximum initial enrichment authorized represents the peak fuel rod enrichment for variably enriched PWR fuel assemblies. The PWR fuel assembly allowable loading characteristics are summarized by fuel assembly type in Table 6.4-1. Table 2.2-1 assembly physical information is limited to the critical analysis input of fuel mass, array configuration, and number of fuel rods. These analysis values are key inputs to the criticality and shielding evaluations in Chapters 5 and 6. Lattice parameters dictating system reactivity are detailed in Chapter 6. Enrichment limits are set for each fuel type to produce reactivities at the

upper safety limit (USL). The maximum TSC decay heat load for the storage of PWR fuel assemblies is 35.5 kW. Uniform and preferential loading patterns are allowed in the PWR basket. The uniform loading pattern permits assemblies with a maximum heat load of 0.96 kW/assembly. The preferential loading pattern permits peak heat loads of 1.20 kW, as indicated in the zone description in Figure 2.2-1. The bounding thermal evaluations are based on the Westinghouse 17×17 fuel assembly. The minimum cool times are determined based on the maximum decay heat load of the contents. The fuel assemblies and source terms that produce the maximum storage and transfer cask dose rates are summarized in Table 5.1-3. A bounding weight of 1,680 pounds, as shown in Table 2.2-1, based on a B&W 15×15 fuel assembly with control components inserted, has been structurally evaluated in each location of the PWR fuel basket.

As noted in Table 2.2-1, the evaluation of PWR fuel assemblies includes thimble plugs (flow mixers), burnable poison rod assemblies (BPRAs), control element assemblies (CEAs), and/or solid filler rods. Empty fuel rod positions are filled with a solid filler rod or a solid neutron absorber rod that displaces a volume not less than that of the original fuel rod.

2.2.2 BWR Fuel Evaluation

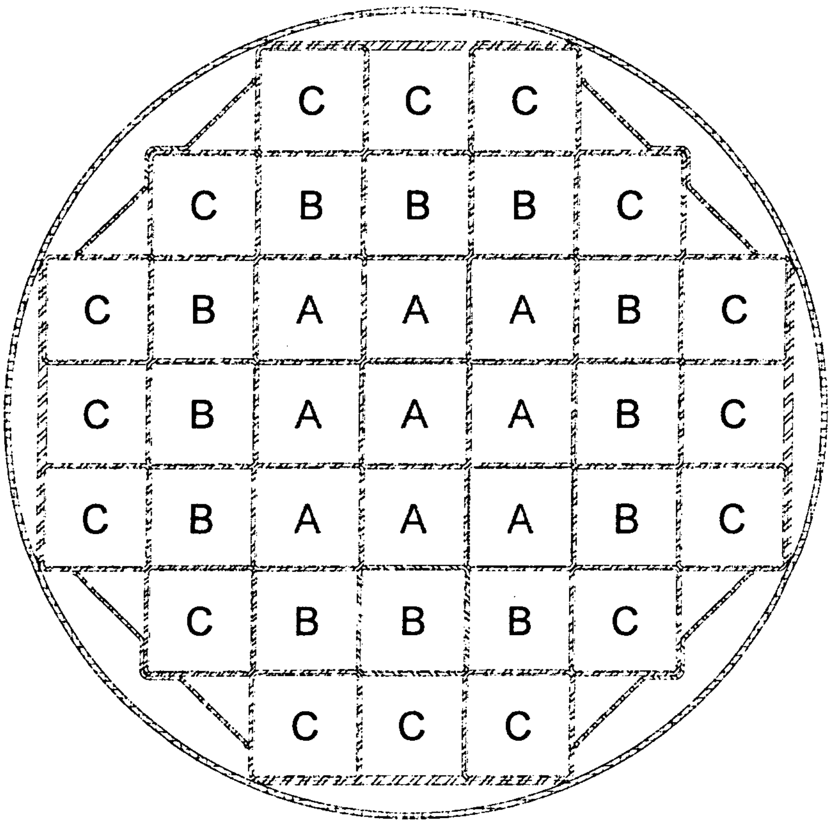
MAGNASTOR evaluations are based on bounding BWR fuel assembly parameters that maximize the source terms for the shielding evaluations, the reactivity for the criticality evaluations, the decay heat load for the thermal evaluations, and the fuel weight for the structural evaluations. These bounding parameters are selected from the various spent fuel assemblies that are candidates for storage in MAGNASTOR. The bounding fuel assembly values are established based primarily on how the principal parameters are combined, and on the loading conditions or restrictions established for a group of fuel assemblies based on its parameters. Each TSC may contain up to 87 intact BWR fuel assemblies. To increase allowed assembly enrichments over those determined for the 87-assembly basket configuration, an optional 82-assembly loading pattern may be used. The required fuel assembly locations in the 82-assembly pattern are shown in Figure 2.2-2.

The limiting parameters of the BWR fuel assemblies authorized for loading in MAGNASTOR are shown in Table 2.2-2. The minimum initial enrichment represents the peak planar-average enrichment. The BWR fuel assembly allowable loading characteristics are summarized by fuel type in Table 6.4-2. Table 2.2-1 assembly physical information is limited to the critical analysis input of fuel mass, array configuration, and number of fuel rods. These analysis values are key inputs to the criticality and shielding evaluations in Chapters 5 and 6. Lattice parameters dictating system reactivity are detailed in Chapter 6. Enrichment limits are set for each fuel type

to produce reactivities at the upper safety limit (USL). The maximum decay heat load per TSC for the storage of BWR fuel assemblies is 33.0 kW (average of 0.379 kW/assembly). Only uniform loading is permitted for BWR fuel assemblies. The bounding thermal evaluations are based on the GE 10×10 fuel assembly. The minimum cooling times are determined based on the maximum decay heat load of the contents. The fuel assemblies and source terms that produce the maximum storage and transfer cask dose rates are summarized in Table 5.1-3. A bounding weight of 704 pounds, as shown in Table 2.2-2, is based on the maximum weight of GE 7×7 and 8×8 assemblies with channels; this weight has been structurally evaluated in each storage location of the BWR basket.

As noted in Table 2.2-2, the evaluation of BWR fuel envelops unchanneled assemblies and assemblies with channels up to 120 mils thick. Empty fuel rod positions are filled with a solid filler rod or a solid neutron absorber rod that displaces a volume not less than that of the original fuel rod.

Figure 2.2-1 PWR Fuel Preferential Loading Zones



Zone Description	Designator	Heat Load (W/assy)	# Assemblies
Inner Ring	A	922	9
Middle Ring	B	1,200	12
Outer Ring	C	800	16

Figure 2.2-2 82-Assembly-BWR Basket Pattern

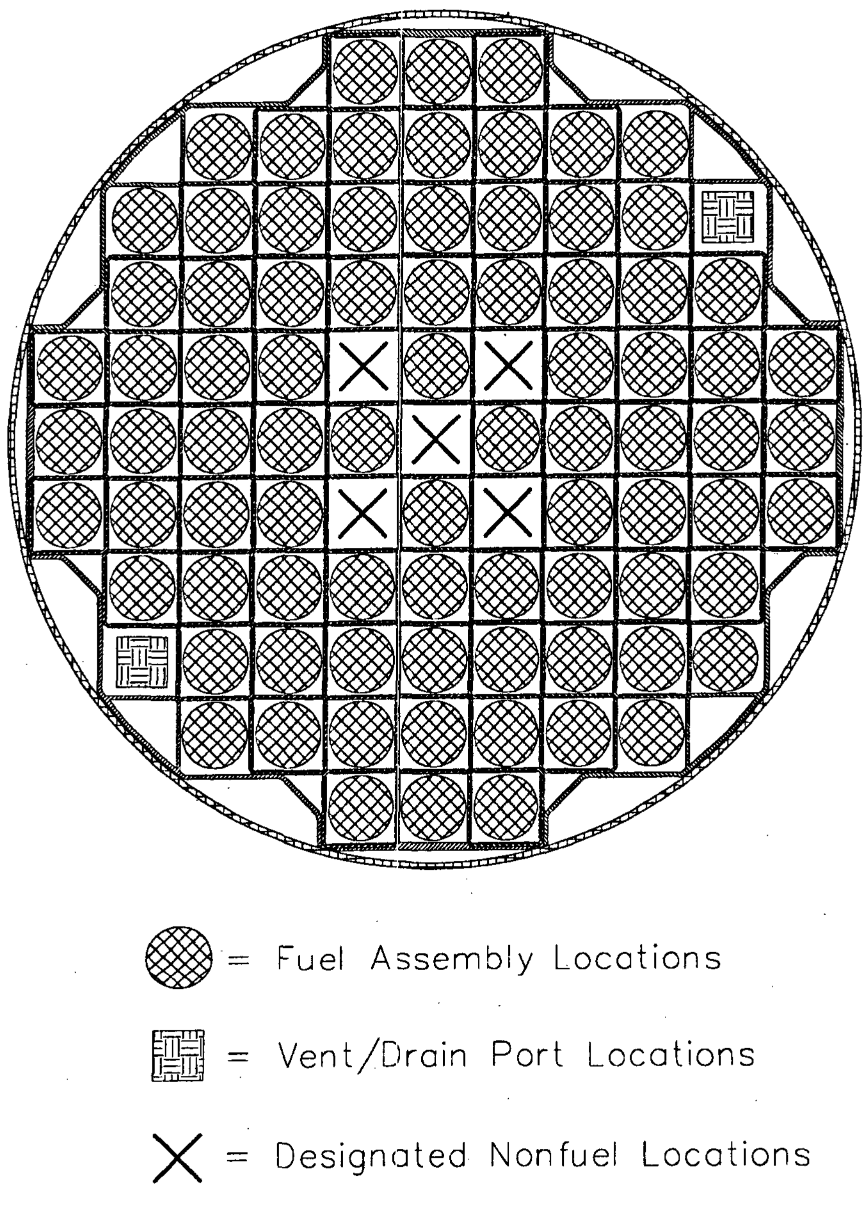


Table 2.2-1 PWR Fuel Assembly Characteristics

Characteristic	Fuel Class					
	14×14	14×14	15×15	15×15	16×16	17×17
Base Fuel Type[a]	CE, SPC	W, SPC	W, SPC	BW, FCF	CE	BW, SPC, W, FCF
Max Initial Enrichment (wt% ^{235}U)	5.0	5.0	5.0	5.0	5.0	5.0
Min Initial Enrichment (wt% ^{235}U)	1.3	1.3	1.3	1.3	1.3	1.3
Number of Fuel Rods	176	179	204	208	236	264
Max Assembly Average Burnup (MWd/MTU)	60,000	60,000	60,000	60,000	60,000	60,000
Peak Average Rod Burnup (MWd/MTU)	62,500	62,500	62,500	62,500	62,500	62,500
Min Cool Time (years)	4	4	4	4	4	4
Max Weight (lb) per Storage Location	1,680	1,680	1,680	1,680	1,680	1,680
Max Decay Heat (Watts) per Preferential Storage Location	1,200	1,200	1,200	1,200	1,200	1,200

- Fuel cladding is a zirconium-based alloy.
- All reported enrichment values are nominal preirradiation fabrication values.
- Weight includes the weight of nonfuel-bearing components.
- Assemblies may contain a flow mixer (thimble plug), a burnable poison rod assembly, a control element assembly, and/or solid stainless steel or zirconium-based alloy filler rods.
- Maximum initial enrichment is based on a minimum soluble boron concentration in the spent fuel pool water. Required soluble boron content is fuel type and enrichment specific. Minimum soluble boron content varies between 1,500 and 2,500 ppm. Maximum initial enrichment represents the peak fuel rod enrichment for variably-enriched fuel assemblies.
- Spacers may be used to axially position fuel assemblies to facilitate handling.
- Maximum uniform heat load is 959 watts per storage location.

[a] Indicates assembly and/or nuclear steam supply system (NSSS) vendor/type referenced for fuel input data. Fuel acceptability for loading is not restricted to the indicated vendor provided that the fuel assembly meets the limits listed in Table 6.4-1. Table 6.2-1 contains vendor information by fuel rod array. Abbreviations are as follows: Westinghouse (W), Combustion Engineering (CE), Siemens Power Corporation (SPC), Babcock and Wilcox (BW), and Framatome Cogema Fuels (FCF).

Table 2.2-2 BWR Fuel Assembly Characteristics

Characteristic	Fuel Class			
	7×7	8×8	9×9	10×10
Base Fuel Type[a]	SPC, GE	SPC, GE	SPC, GE	SPC, GE, ABB
Max Initial Enrichment (wt% ^{235}U)	4.5	4.5	4.5	4.5
Number of Fuel Rods	48 49	59 60 61 62 63 64[b]	72 74[c,d] 76 79 80	91[c] 92[c] 96[c,d] 100[d]
Max Assembly Average Burnup (MWd/MTU)	60,000	60,000	60,000	60,000
Peak Average Rod Burnup (MWd/MTU)	62,500	62,500	62,500	62,500
Min Cool Time (years)	4	4	4	4
Min Average Enrichment (wt% ^{235}U)	1.3	1.3	1.3	1.3
Max Weight (lb) per Storage Location	704	704	704	704
Max Decay Heat (Watts) per Storage Location	379	379	379	379

- Each BWR fuel assembly may have a zirconium-based alloy channel up to 120 mil thick.
- Assembly weight includes the weight of the channel.
- Maximum initial enrichment is the peak planar-average enrichment.
- Water rods may occupy more than one fuel lattice location. Fuel assembly to contain nominal number of water rods for the specific assembly design.
- All enrichment values are nominal preirradiation fabrication values.
- Spacers may be used to axially position fuel assemblies to facilitate handling.

[a] Indicates assembly vendor/type referenced for fuel input data. Fuel acceptability for loading is not restricted to the indicated vendor/type provided that the fuel assembly meets the limits listed in Table 6.4-2. Table 6.2-2 contains vendor information by fuel rod array. Abbreviations are as follows: General Electric/Global Nuclear Fuels (GE), Exxon/Advanced Nuclear Fuels/Siemens Power Corporation (SPC).

[b] May be composed of four subchannel clusters.

[c] Assemblies may contain partial-length fuel rods.

[d] Composed of four subchannel clusters.

Chapter 4

Chapter 4
Thermal Evaluation

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4.1 Discussion

MAGNASTOR consists of a TSC, concrete cask, and a transfer cask. In long-term storage, the fuel is loaded in a basket structure positioned within the TSC. The TSC is placed in the concrete cask, which provides passive radiation shielding, structural protection and natural convection cooling. The transfer cask is used to handle the TSC. The thermal performance of the concrete cask containing a loaded TSC with design basis fuel, and the performance of the transfer cask containing a loaded TSC with design basis fuel are evaluated in this chapter.

The thermal evaluation considers normal conditions and off-normal and accident events of storage. Each of these conditions can be described in terms of the environmental temperature, use of solar insolation, and the condition of the air inlets as shown in Table 4.1-1. For the transfer operation evaluation, a separate model including the optional use of a TSC cooling system is used, or no additional annulus cooling is used. The evaluation of the different phases of the transfer operation is accomplished by altering the properties of the medium in the canister to correspond to water, helium or vacuum.

In order for the heat from the stored spent fuel assemblies to be rejected to the ambient via the concrete cask or the transfer cask, the decay heat from the spent fuel assemblies must be transferred to the TSC surface. The MAGNASTOR baskets for the PWR and the BWR fuel assemblies rely on all three heat transfer modes—radiation, conduction and convection—to transfer the heat to the TSC surface. The basket design enhances convection heat transfer. Helium is used as the backfill gas in the TSC because its thermal conductivity is better than other allowable backfill gases. Since the basket is comprised of full-length carbon steel tubes, it provides a significant path for conduction heat transfer. Radiation is a significant mode of heat transfer in the fuel region and between the outer surface of the basket and the TSC shell.

The significant thermal design feature of the concrete cask is the passive convective airflow around the outside of the TSC. Cool (ambient) air enters at the bottom of the concrete cask through four air inlets. Heated air exits through the four air outlets in the upper concrete cask body. Radiant heat transfer occurs from the TSC shell to the concrete cask liner, which then transmits heat to the annular airflow. Conduction through the concrete cask, although not significant, is included in the analytical model. Natural circulation of air through the concrete cask annulus, in conjunction with radiation from the TSC surface, maintains the fuel cladding temperature and all component temperatures below their design limits.

The MAGNASTOR design basis heat load is 35.5 kW for 37 PWR fuel assemblies. The PWR fuel basket can accommodate a uniform heat load of 959 W per assembly, or a preferential

loading pattern as shown in Figure 4.1-1. The preferential loading pattern identified in Figure 4.1-1 defines three values of heat generation that place the fuel assemblies with the maximum heat generation rate in an intermediate region of fuel storage locations. This configuration enhances convection, while not incurring the penalty from the maximum heat-generating assemblies being in the center of the basket region. The BWR fuel basket can accommodate 87 fuel assemblies with a uniform design basis total heat load of 33 kW, or 379 watts, per assembly.

The thermal evaluation applied different component temperature limits and allowable stress limits for long-term conditions versus short-term conditions. Normal storage operation is considered to be a long-term condition. Off-normal and accident events are considered to be short-term conditions. Thermal evaluations are performed for the design basis PWR and BWR fuels for all design conditions. The maximum allowable material temperatures for long-term and short-term conditions are provided in Table 4.1-2.

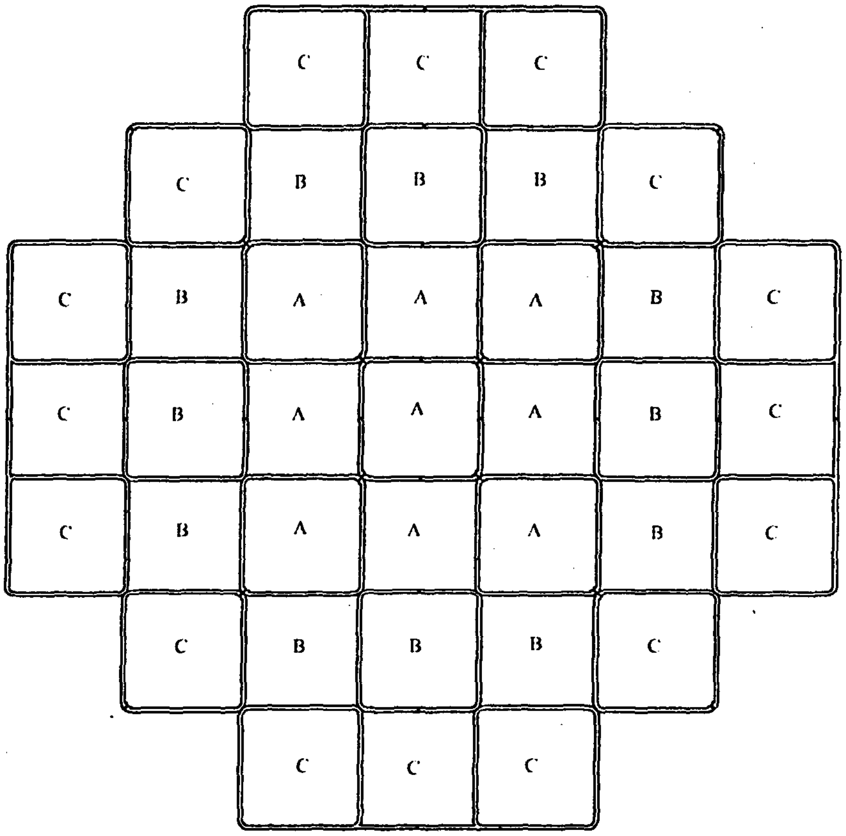
During normal conditions of storage and off-normal and accident events, the concrete cask must reject the decay heat from the TSC to the environment without exceeding the system components temperature limits. In addition, to ensure fuel rod integrity for normal conditions of storage, the spent fuel must be maintained at a sufficiently low temperature in an inert atmosphere to preclude thermally induced fuel rod cladding deterioration. To preclude fuel degradation, the maximum cladding temperature under normal conditions of storage and canister transfer operations is limited to 752°F (400°C) per ISG-11 [2]. The maximum cladding temperature for off-normal and accident events is limited to 1,058°F (570°C). For the structural components of the storage system, the thermally induced stresses, in combination with pressure and mechanical load stresses, are limited to the material allowable stress levels.

Thermal evaluations for normal conditions of storage and canister transfer operations are presented in Section 4.4. The finite element method is used to compute the effective properties for the basket and fuel region. The thermal solutions for the concrete cask and transfer cask are obtained using finite volume methodology. Thermal models used in the evaluation of normal and transfer conditions are described in Section 4.4.1.

A summary of the thermal evaluation results for normal conditions of storage is provided in Table 4.4-3 for the PWR and the BWR cases. Table 4.4-4 contains the maximum fuel cladding temperatures for the different phases of the transfer operations. Thermal evaluation results for off-normal and accident events are presented in Sections 4.5 and 4.6, respectively. The results demonstrate that the calculated temperatures are less than the allowable fuel cladding and component temperatures for all normal (long-term) storage conditions and for short-term events.

As shown in Chapter 3, the thermally induced stresses, combined with pressure and mechanical load stresses, are also within allowable limits.

Figure 4.1-1 Definition of the Preferential Loading Pattern for PWR Fuel



Zone Identification	A	B	C
Maximum Heat Load per Assembly (kW)	0.922	1.20	0.80
Total Number of Fuel Assemblies	9	12	16

Table 4.1-1 Summary of Thermal Design Conditions for Storage for the MAGNASTOR

Condition		Environmental Temperature (°F)	Solar Insolation [a]	Condition of Concrete Cask Inlets
Normal		76	Yes	All inlets open
Off-Normal - Half Air Inlets Blocked		76	Yes	Half inlets blocked
Off-Normal - Severe Heat		106	Yes	All inlets open
Off-Normal - Severe Cold		-40	No	All inlets open
Accident - Extreme Heat		133	Yes	All inlets open
Accident - All Air Inlets Blocked		76	Yes	All inlets blocked
Accident - Fire	During Fire	1475	Yes	All inlets open
	Before and After Fire	76	Yes	All inlets open

[a] Solar Insolation per 10 CFR 71 [3]:
Curved Surface: 400 g cal/cm^2 (1475 Btu/ft^2) for a 12-hour period.
Flat Horizontal Surface: 800 g cal/cm^2 (2950 Btu/ft^2) for a 12-hour period.

Table 4.1-2 Maximum Allowable Material Temperatures

Material	Temperature Limits (°F)		Reference
	Long Term	Short Term	
Concrete	200(B)/300(L)[a]	350	ACI-349 [4] NUREG-1567 [20]
Fuel Clad PWR Fuel BWR Fuel	 752 752	 752/1,058[b] 752/1,058[b]	 ISG-11 [2] and PNL-4835 [5]
NS-4-FR	300	300	JAPC [6]
Chemical Copper Lead	600	600	Baumeister [7]
ASME SA693 17-4PH Type 630 Stainless Steel	650	800	ASME Code [8] ARMCO [9]
ASME SA240 Type 304 Stainless Steel	800	800	ASME Code [8]
ASTE SA537 Class 1 Carbon Steel	700	700/1,000[c]	ASME Code [8]
ASTM A588 Carbon Steel	700	700	ASME Code Case N-71-17 [10] ASTM Standard [19]
ASTM A350 LF2 Carbon Steel	700	700	ASTM Standard [19]
ASTM A36 Carbon Steel	700	700	ASME Code Case N-71-17 [10] ASTM Standard [19]

a B and L refer to bulk temperatures and local temperatures, respectively.
b 752°F TSC transfer operations; 1,058°F off-normal and accident events.
c 700°F TSC transfer operations; 1,000°F off-normal and accident events.

entity, porous media is used in the modeling. The porous media model allows the effect of the reduced flow area of the fuel rods and the fuel assembly grids to be considered in representing the momentum of the helium flow by including a pressure drop based on the geometry of the fuel assembly, i.e., the pitch of the fuel rods, the fuel rod diameter, and the fuel assembly grid geometry. Additional fluid flow analyses are required to determine the constants inherit in the porous media use for flow between cylindrical-shaped fuel rods and for fuel assembly grids. The determination of porous media constants is presented in Section 4.8.2. The flow of helium in the downcomer regions in the TSC does not require special consideration of effective flow conditions. To confirm that the use of a two-dimensional model for the TSC is an acceptable and conservative methodology, a benchmark is provided in Section 4.8.1.

The thermal evaluation for the transfer conditions is performed using the two-dimensional axisymmetric models of the transfer cask and TSC, as presented in Section 4.4.1.5. Similar to the model of the concrete cask and TSC, the fuel basket and fuel assemblies inside the TSC in the transfer cask are modeled as homogeneous regions using effective thermal properties.

4.4.1.1 Two-Dimensional Axisymmetric Concrete Cask and TSC Models

This section describes the finite volume models used to evaluate the thermal performance of the concrete cask and TSC for the PWR and BWR fuel configurations. As shown in Figure 4.4-1, the two-dimensional axisymmetric concrete cask and TSC model includes the following:

- Concrete cask, including lid, liner, pedestal and stand
- Air in the air inlets, the annulus and the air outlet
- TSC shell, lid and bottom plate
- Basket with fuel and neutron absorber
- Helium internal to the TSC

The fuel basket, fuel and neutron absorber are modeled as homogeneous regions with effective properties. The effective thermal conductivities for the TSC internals in the radial and axial directions are determined using the two-dimensional models as detailed in Section 4.4.1.2.

The two-dimensional axisymmetric concrete cask and TSC model is used to perform computational fluid dynamic analyses to determine the mass flow rate, velocity and temperature of the airflow in the annulus region, as well as for the helium flow internal to the TSC. Since the concrete cask and its components are contained in the model, the temperature distributions in the concrete and the concrete cask steel liner are also determined. Two models are generated for the evaluations—the PWR system and the BWR system, respectively. These models are identical, except for differences in dimensions of the active fuel region and the effective properties of the

TSC internals. Figure 4.4-2 shows an overall view of the cells employed in the model representing both the concrete cask and the TSC containing a design basis fuel heat load.

Modeling of the Concrete Cask

The concrete cask body has four air inlets at the bottom and four air outlets at the top. Since the configuration is symmetrical, it can be simplified into a two-dimensional axisymmetric model by using equivalent dimensions for the air inlets and outlets, which are assumed to extend around the concrete cask periphery. The vertical air gap is an annulus, with a radial width of 3.5 inches. This radial dimension of the air annulus between the TSC shell and the concrete cask liner is modified to a smaller effective value to account for the reduction of the airflow cross-sectional area due to the standoffs welded to the liner. The bottom ends of the standoffs are more than 63 inches from the bottom of the TSC, which means that for over 30% of the length of the annulus, the standoffs do not exist. The model conservatively represents them as being the full length of the TSC. The additional axial conductance from the standoffs is conservatively neglected. Thermal radiation across the annulus gap is considered in the model, and the emissivities of the TSC surface and the concrete cask liner are reported in Chapter 8. Heat being radiated to the concrete cask liner is transferred into the annulus by convection, as well as being conducted through the concrete cask wall.

The most significant mechanism for rejecting heat into the environment is through the movement of air up through the annulus. The airflow in the vertical annulus is modeled as transitional turbulent flow using the k-ω turbulence model in FLUENT [12]. This determination was made through the use of a thermal test of PWR canistered fuel contained in a vertical concrete cask, which is described in EPRI Report TR-100305 [21] and provides a description of the test canister, the concrete cask, the fuel assemblies, and the boundary conditions employed in a series of tests. The total heat load of the fuel used in the tests was 14.9 kW. Extensive temperature measurements were made for the basket, fuel, canister and concrete cask for each test conducted. The thermal test of interest employed the vacuum condition for the canister. This test was selected since it removed the influence of convection inside the canister and simplified the thermal model inside the canister. FLUENT was used to perform a two-dimensional steady-state axisymmetric analysis of the system described in [21] using two turbulent flow models: a low Reynold's number turbulence model (low Re k-ε) and a transitional turbulence model (k-ω). Technical details for these turbulence models are contained in the documentation for FLUENT. The thermal models and boundary conditions used in the analyses are detailed in Section 4.8.3. Results for the temperature profiles for the canister surface and the concrete liner surfaces for both turbulence models are shown in Figure 4.8.3-3 and Figure 4.8.3-4. The results indicate that

both turbulence models yield conservative predictions for the temperature profiles and that both the low Reynold's number k-ε and the k-ω models are appropriate for use in the analysis of air flow up through the annulus between the canister and the concrete cask. Since the use of the k-ω model provides conservative results for the canister shell and concrete cask for a test corresponding to 14.9 kW, the use of the k-ω model is also considered to be appropriate for analyses having larger heat loads. As the heat load is increased, the turbulence in the annulus air flow is also expected to increase. The results of the analysis for the thermal tests are considered as validation for the use of the k-ω turbulence model for the annulus region of MAGNASTOR.

The mesh corresponding to the annulus for the analysis is shown in Figure 4.4-2. Increased cell density is used in the annulus region adjacent to the wall to allow the y+ at the wall to be on the order of unity, ensuring proper turbulence modeling.

The TSC model is included with the concrete cask model as shown in Figure 4.4-1. Boundary conditions at the edges of the model to the ambient are applied to the concrete cask surfaces. The heat flux being transferred from the helium internal to the TSC through the TSC shell and into the air annulus region is not considered to be a boundary condition for the concrete cask since all of these components are included in the same model. The boundary conditions applied to the outer surface of the concrete cask include the following.

- Solar insolation to the outer surfaces of the concrete cask.
- Natural convection heat transfer at the outer surfaces of the concrete cask.
- Radiation heat transfer at the concrete cask outer surfaces.

Solar Insolation

The solar insolation on the concrete cask outer surfaces is considered in the model. The incident solar energy is applied based on 24-hour averages as shown:

$$\text{Side surface:} \quad \frac{1475\text{Btu/ft}^2}{24\text{hrs}} = 61.46\text{Btu/hr}\cdot\text{ft}^2$$

$$\text{Top surface:} \quad \frac{2950\text{Btu/ft}^2}{24\text{hrs}} = 122.92\text{Btu/hr}\cdot\text{ft}^2$$

Natural Convection

Natural convection heat transfer at the outer surfaces of the concrete cask is evaluated by using the heat transfer correlation for vertical and horizontal plates. This method assumes a surface temperature and then estimates Grashof (Gr) or Rayleigh (Ra) numbers to determine whether a heat transfer correlation for a laminar flow model or for a turbulent flow model should be used.

Since Grashof or Rayleigh numbers are much higher than the values defining the transition from laminar to turbulent flow, correlation for the turbulent flow model is used as shown in the following.

Side surface (Kreith) [13]:

$$Nu = 0.13(Gr \cdot Pr)^{1/3} \qquad \text{for } Gr > 10^9$$
$$h_c = Nu \cdot k_f / H_{vcc}$$

Top surface (Incropera) [14]:

$$Nu = 0.15 Ra^{1/3} \qquad \text{for } Ra > 10^7$$
$$h_c = Nu \cdot k_f / L$$

where:

Gr	----------	Grashof number
h_c	----------	Average natural convection heat transfer coefficient
H_{vcc}	----------	Height of the concrete cask
k_f	----------	Conductivity
L	----------	surface characteristic length, L = area / perimeter
Nu	----------	Average Nusselt number
Pr	----------	Prandtl number
Ra	----------	Rayleigh number

All material properties required in these equations are evaluated based on the film temperature defined as the average value of the surface temperature and the ambient temperature.

Radiation Heat Transfer

The radiation heat transfer between the outer surfaces of the concrete cask and the ambient environment is evaluated in the model by calculating an equivalent radiation heat transfer coefficient.

$$h_{rad} = \frac{\sigma(T_1^2 + T_2^2)(T_1 + T_2)}{1/\varepsilon_1 + 1/\varepsilon_2 + 1/F_{12} - 2} \qquad [14]$$

where:

h_{rad}	----------	Equivalent radiation heat transfer coefficient
F_{12}	----------	View factor

T_1 & T_2	--	Surface (T_1) and ambient (T_2) temperatures
ε_1 & ε_2	--	Surface (ε_1) and ambient (ε_2=1) emissivities
σ	--	Stefan-Boltzmann Constant

At the concrete cask side, an emissivity for a concrete surface of $\varepsilon_1 = 0.9$ is used and a calculated view factor (F_{12}) = 0.182 [14] is applied. The view factor is determined by conservatively assuming that the cask is surrounded by eight casks. At the cask top, an emissivity, ε_1, of 0.8 is conservatively used (emissivity for concrete is 0.9), and a view factor, F_{12}, of 1 is applied.

Modeling of the TSC

The TSC is a closed system designed so that pressurized helium can circulate inside the TSC and transfer heat from the fuel in the basket to the TSC shell. Additionally, the basket permits heat to be conducted from the interior regions of the basket to the periphery of the basket, then radiated and convected to the TSC shell surface. The stiffeners at the periphery of the basket do provide a path of conduction to the TSC shell, even though a small gap exists between the stiffeners and the TSC shell. The heat conduction through these stiffeners is neglected in the evaluation, which is considered to be conservative. Radiation is modeled in the fuel assemblies, as well as in gaps in the basket. Heat transfer to the TSC lid and bottom plate is considered in the analysis, but it is not a major contributor to the heat-rejection process. Two separate models are generated—one for the PWR fuel configuration and one for the BWR fuel configuration. The differences between the two models are in the dimensions of the basket region and the effective properties derived for each basket and fuel region.

The TSC region consists of the following: the TSC shell, the TSC bottom plate, the TSC lid, the fuel basket region, and the helium-filled volume outside the fuel basket region. The fuel basket region is subdivided into three sections to reflect the location of the active fuel region with the associated heat generation and the fuel regions above and below the active fuel regions. These three separate regions are shown in Figure 4.1-1.

The cross-section of the flow path for the helium in the fuel basket and TSC significantly changes between the flow up through the basket region and the flow down in the downcomer region next to the TSC shell. For the flow up through the basket, the outline of the cross-sectional area is comprised of the area between the square basket tubes and circular fuel pins. Additionally, as the helium flows up through the basket tube, the fuel assembly grids will provide resistance to the flow. In the downcomer region, the exterior boundary is circular, while the interior boundary is the edge of the square fuel tubes. This is also an irregular-shaped area. In a two-dimensional representation of these areas, the concept of the hydraulic diameter is

employed, which is commonly used to determine an equivalent cross-sectional area for a cross-section with complex shapes.

To account for the resistance to flow in the fuel region in the basket due to the wetted perimeter of the fuel region in the basket, the porous media option for fluids is used. The resistance to flow due to the fuel pins and the fuel assembly grids is represented in terms of a pressure drop included in the momentum equations for each cell in the model associated with porous media. The expression for the pressure drop used in FLUENT is given by:

$$\frac{\Delta P}{L} = \frac{\mu}{\alpha \cdot \varepsilon} V + C(\frac{1}{2} \rho V^2)$$

where:

$\Delta P/L$	---	pressure drop per unit length (Pa/m)
V	---	superficial fluid velocity (m/s)
μ	---	fluid viscosity (kg/m-s)
ρ	---	fluid density (kg/m^3)
$1/\alpha$	---	viscous flow resistance (m^{-2})
ε	---	porosity factor, which is the ratio of the cross-sectional area of the flow, to the cross-sectional area of the porous media region in the FLUENT model
C	---	inertial resistance factor (m^{-1})

In this expression, the viscosity is input as a temperature-dependent material property for the helium, and the density is computed during the solution based on the ideal gas law. The permeability is based on the geometry of the fuel rods and the fuel assembly grid. Since the velocities are on the order of 0.03 m/s or less, the second term comprised of V^2 is considered to be insignificant as compared to the first term. Therefore, the calculation for the inertial resistance factors is neglected. Details of the calculation of the viscous flow resistance factors are contained in Section 4.8.2. The values used for the evaluation are based on the bounding fuel parameters.

The downcomer region of the TSC does not use a porous media model. The areas of the downcomer regions are calculated to be 600 inches^2 and 550 inches^2 for the PWR and the BWR fuel baskets, respectively. These areas are used to calculate the effective outer diameter of the fuel basket region, which serves as the radial boundary for the porous media region for the fuel.

Due to the large cross-section for the flow up through the fuel basket, the helium velocity is expected to be sufficiently low to correspond to laminar flow. In the downcomer region, the gas

velocities would result in the flow being in a transitional regime. Conservatively, all helium flow in the TSC is taken to be laminar.

The porous media representation of the fuel basket region incorporates orthotropic effective thermal conductivities. The axial conductance in the fuel basket region is due to the significant cross-sectional area of the fuel tubes and the fuel assemblies. The in-plane conductance is associated with the conductance of the fuel tubes, as well as the effective conductivities of the fuel assembly and neutron absorber. The effective conductivity of the fuel basket region is determined in two steps. Separate effective thermal conductivities for the two-dimensional fuel assembly and the neutron absorber are computed for the axial and the in-plane directions using two finite element models. Details for these models are described in Section 4.4.1.3 for the fuel assemblies and Section 4.4.1.4 for the neutron absorber. In these sections, both the PWR and the BWR effective properties calculations are performed.

The resulting conductivities for the fuel assemblies and neutron absorber are then used in a single two-dimensional planar model of the cross-section of the basket, which is used to determine the axial and in-plane conductivities for the fuel basket region associated with the porous media. This model is described in Section 4.4.1.2. The effective conductivity for the porous media model uses two conductivities (k_f k_s), as identified in the following equation.

$$K_{eff} = \varepsilon \times k_f + (1-\varepsilon) \times k_s$$

where:

ε -- porosity factor
k_f -- thermal conductivity of the helium
k_s -- thermal conductivity associated with the solid portion of the porous media model

Heat Generation

The heat generation for the fuel is applied to the active fuel region of the TSC model (see Figure 4.4-1) for the PWR and the BWR fuel assemblies. The maximum design basis heat loads to be considered for the PWR and the BWR fuel basket configurations are 35.5 kW and 33 kW, respectively.

For the PWR fuel basket, two patterns of heat generation are considered. A uniform loading of 35.5 kW or 959 W in each fuel location is considered. The axial power distribution for PWR fuel, as shown in Figure 4.4-3, is included in applying the heat generation. An optional heat generation pattern, as shown in Figure 4.1-1 is also considered and has the same total heat load of 35.5 kW. The application of the heat generation for this condition incorporates an axial

distribution and a radial distribution. The area over which each fuel assembly heat load is distributed in Figure 4.1-1 is determined on the basis of the cross-section of the fuel tubes containing the specific heat loads identified as A, B and C in Figure 4.1-1. The heat generation values specified in Figure 4.1-1 are considered to be the maximum permissible heat generation in each fuel location.

For the BWR fuel basket. only a uniform thermal loading pattern is considered. The design basis heat load for BWR fuel is 33 kW, which corresponds to a maximum heat load of 379 watts for each of the 87 fuel assemblies. The axial power distribution for the BWR fuel is shown in Figure 4.4-4. For some BWR fuel assembly enrichments, the five fuel locations in the center of the BWR basket will not be loaded. In this configuration, the fuel assembly decay heat is limited to 379 watts. Fuel storage locations not containing a fuel assembly will have an effective fuel cell insert installed to prevent the helium flow from bypassing the fuel locations containing fuel assemblies. The configuration with a partially loaded fuel basket containing BWR fuel assemblies with a maximum heat load of 379 watts per assembly is considered to be bounded by the fully loaded BWR fuel basket configuration. Temperatures obtained from analyses performed using the maximum heat load in conjunction with a fully loaded BWR basket are considered to bound the results for a partially loaded basket.

Pressure of the Helium Backfill

To drive the convection internal to the TSC, it is necessary to increase the density of the helium. Since the free volume in the TSC remains constant, the density of the backfill gas can be increased by backfilling the TSC to a range of pressures and temperatures that would result in an increase in the density. In the MAGNASTOR design, the TSC is pressurized to 7 atm (gauge) for the helium backfill for normal conditions. Since the gas in the model is characterized as an ideal gas, the increased density in the analysis can be indirectly obtained by specifying a pressure in the TSC region. For the PWR normal condition, the density of helium in the TSC associated with a pressure of 7 atm (g) is (0.763g/liter). It is important to assess the effect of the helium density on the performance of the system. The evaluation of the sensitivity of the peak fuel temperature to the pressure is performed using the PWR model described in this section. The condition requiring a change is the pressure that is applied to the TSC region of the model. The results of the model solutions for pressures of 1 atm (g), 3 atm (g), 5 atm (g) and 7 atm (g) are shown as a graph in Figure 4.4-5. As shown in Figure 4.4-5, the variation of the peak cladding temperature with the pressure specified inside the TSC is a nonlinear function. The peak cladding temperature decreases sharply when the pressure increases from 1 atm to 3 atm. Subsequent increases in the pressure to 5 atm and 7 atm do not result in the same rate of decrease

of the clad temperature as for the 1 atm and 3 atm cases. The model of the TSC in the concrete cask has two regions of convection separated by a TSC shell. Heat can only be transferred through the shell from the TSC internal region to the annulus region outside the TSC. The flow characteristics in the annulus region are primarily affected by the total heat generation being transferred through the TSC shell, as well as the geometry of the annulus. As the pressure (and the associated mass) of the gas in the TSC is increased, the buoyancy force inside the TSC is increased. This increases the mass flow rate of the TSC gas so that the ability to reject heat from the fuel is also increased. This would tend to reduce the maximum clad temperature. However, the flow in the annulus is not expected to be significantly affected by the velocity of the gas internal to the TSC. Therefore, regardless of the buoyancy force inside the TSC, the maximum clad temperature is limited by the shell temperature, which is controlled by the annulus flow. At some pressure level, an increase in the TSC pressure (and mass) of the gas would not significantly decrease the fuel clad temperature, which would imply a reduced derivative of the clad temperature with respect to the pressure. This is the characteristic of the curve in Figure 4.4-5, which implies that further increase in the pressure does not result in a significant reduction of the clad temperature. There is an advantage in operating in this regime of the curve in that the sensitivity of the clad temperature due to a reduction in the helium density is reduced. This evaluation demonstrates that even with a 10% loss of density, the peak clad fuel temperatures remain under 752°F (400°C).

Mesh Sensitivity Evaluation

With respect to the sensitivity of the calculated fuel cladding, concrete cask and TSC temperatures to the number of divisions of the finite volume cells, this need only be addressed for the regions containing fluid flow. For the solid regions, such as the concrete or the steel components, the sensitivity evaluation of cell refinement is not required.

There are two fluid regions in the model: the airflow annulus region outside the TSC, and the helium region inside the TSC. Each of these fluid regions uses a different fluid flow model. The TSC internal flow is modeled utilizing a laminar flow model; the airflow in the annulus region is modeled using a turbulent flow model.

In the concrete cask annulus region, the modeling accuracy of the turbulent flow depends not on the usual refined mesh near the wall, as for a laminar flow condition, but on the value of y+, as previously discussed. The cell divisions in the annulus region have been set to permit the y+ to be less than unity, which is acceptable according to FLUENT documentation. Therefore, further refinement of the annulus region would not provide a more accurate temperature result.

For the helium flow in the TSC (laminar flow), the largest velocities are in the downcomer regions and, essentially, the entire heat load must be transferred to the TSC shell. The focus of the sensitivity evaluation is the number of cell divisions in the downcomer region. The largest velocity gradients in the downcomer regions occur in the radial direction, not in the axial direction. To determine the sensitivity of the radial divisions in the downcomer region, the number of radial divisions modeled was increased by a factor of two. The axial divisions in the downcomer region remain the same. The mesh refinement in the air annulus and in the concrete cask remains unchanged. The condition used in the evaluation corresponded to the normal condition using a uniform heat loading of 40 kW, which bounds the design basis condition for the 35.5 kW. The results of this evaluation showed that the maximum fuel temperature changed by less than 1°F for the increased refinement mesh. The temperature of the TSC shell showed a decrease of 2°F for the mesh with the increased refinement. This indicates that the maximum fuel temperature is relatively insensitive to the mesh refinement in the downcomer region.

Heat Transfer by Radiation

Thermal radiation in all fluid (air and helium) regions has been considered in the model, specifically the following.

- Thermal radiation across the air annulus between the TSC shell and the concrete cask liner.
- Thermal radiation across the air gap above the TSC lid and in the isolated air region below the pedestal of the concrete cask.
- Thermal radiation across the helium downcomer region between the fuel basket and the TSC shell.

The discrete ordinates (DO) radiation model in FLUENT is used to solve the radiative heat transfer equation with emissivity values applied on the solid material surfaces.

Radiation in the porous media fuel region is modeled by using equivalent thermal conductivities that include the effects of heat transfer by radiation. The model of the porous media region in FLUENT is enclosed by a vertical wall that separates the porous region from the downcomer. The wall is comprised of two sides; one side facing the inner surface of the canister and the other facing the interior region of the porous media. An emissivity corresponding to electroless nickel is applied to the side facing the canister surface. On the side of the wall facing the interior region of the porous media, an emissivity of zero is applied to avoid incorporating the radiation already taken into account using the effective properties for the basket.

4.4.1.2 Two-Dimensional Fuel Basket Models

The purpose of the two-dimensional fuel basket model is to determine the effective thermal conductivity of the basket region in the axial and radial directions. The effective conductivities are used in the two-dimensional axisymmetric concrete cask and TSC models, and the two-dimensional axisymmetric transfer cask and TSC models. Three types of media are considered in the TSC: helium, water and vacuum. The fuel assemblies and neutron absorbers in the fuel basket model are shown as homogeneous regions with effective thermal properties, which are determined by the two-dimensional fuel assembly models and the two-dimensional fuel tube models described in Sections 4.4.1.3 and 4.4.1.4, respectively. The analyses performed in Section 4.4.1.3 identify that the PWR fuel assembly with the minimum conductivity is the 14×14. The properties of the PWR 14×14 fuel assembly are used in the evaluation of the effective properties for the PWR basket in this section. For the BWR assembly, the bounding fuel assembly type is the 10×10, which is used to determine the effective properties for the BWR basket.

Since the effective properties for the fuel basket correspond to the basket region, which is comprised of full-length fuel tubes, it is only necessary to consider a cross-section of the basket with a two-dimensional planar model. Due to symmetry of the basket designs, only a 1/8-section model is required for the PWR and the BWR fuel baskets. ANSYS is used to perform the conduction analysis using the models shown in Figure 4.4-6 for the PWR fuel basket and Figure 4.4-7 for the BWR fuel basket. The models include only radiation and conduction heat transfer. Radiation heat transfer is incorporated into the effective properties for the fuel assemblies and the neutron absorbers. Each fuel basket model takes into account the size of the cells in the basket – i.e., those cells formed directly by the fuel tube, and those cells formed by adjacent fuel tubes. The neutron poison is contained only in the inner surface of the basket tubes. The exterior tubes, which form the boundary of the downcomer region, may not have neutron absorbers on the inner surface of those fuel tubes. In the condition where the neutron absorbers are not present, aluminum plates may be substituted, but are not required. The PWR and BWR fuel basket models evaluated in this section use the conductivity of the neutron poison defined in Chapter 8. The absence of neutron absorber on the exterior fuel tubes has an insignificant effect on the radial transfer of heat. The removal of the neutron absorber actually increases the flow area in the tubes.

Additionally, it is conservatively assumed for both the PWR and BWR fuel baskets that a gap between the fuel tubes exists for the full length of the tube without any contact, as shown in Figure 4.4-6 and Figure 4.4-7. The gap between the fuel tubes is modeled as being 0.01 inch,

and the conduction through the gap is based on the presence of either helium or water, depending on the condition.

The effective thermal conductivity (K_{eff}) of the fuel basket region in the radial direction is determined by considering the basket region as a solid cylinder with heat generation.

Considering the temperature at the center of the TSC to be T_{max}, the effective thermal conductivity (K_{eff}) is shown:

$$K_{eff} = \frac{Q}{4\pi H(T_{max} - T_o)} = \frac{Q}{4\pi H\Delta T} \quad [15]$$

where:

Q	total heat generated by the fuel (Btu/hr)
H	length of the active fuel region (in)
T_o	boundary temperature of the basket
ΔT	T_{max} - T_o (°F)

The value of ΔT is obtained from thermal analysis using the two-dimensional models shown in Figure 4.4-6 and Figure 4.4-7, with the boundary temperature constrained to be T_o. The effective conductivity (K_{eff}) is then determined by using the stated expression. The analysis is repeated by applying different boundary temperatures so that temperature-dependent conductivities can be determined.

4.4.1.3 Two-Dimensional Fuel Assembly Models

The two-dimensional fuel assembly models include the fuel pellets, cladding, and the media occupying the space between fuel rods. The media is considered to be helium for storage conditions, and water, vacuum or helium for transfer conditions. The two-dimensional finite element models of the fuel assemblies are used to determine the effective conductivities for the PWR and BWR fuel assemblies. The effective conductivities are used in the two-dimensional fuel basket models described in Section 4.4.1.2. For the PWR fuel assemblies, four separate types are considered: 14×14, 15×15, 16×16 and 17×17. For the BWR fuel assemblies, four separate types are considered: 7×7, 8×8, 9×9 and 10×10. For the BWR fuel assembly, a fuel channel is considered since it may be present and it will result in bounding fuel cladding temperatures. Therefore, it is only necessary to address a single fuel configuration for each of the fuel assembly types.

The two-dimensional fuel assembly models include the fuel pellets, cladding, media between fuel rods, media between the fuel rods and the inner surface of the fuel tube (PWR) or between

the fuel rods and the inner surface of the fuel channel (BWR), and helium in the gap between the fuel pellets and cladding. The media are considered to be helium for storage, and water, vacuum or helium for transfer conditions. Modes of heat transfer modeled include conduction and radiation between individual fuel rods for the steady-state condition. ANSYS PLANE55 conduction elements and MATRIX50 radiation elements are used to model conduction and radiation. (Radiation is not considered for the water condition.) Radiation elements are defined between fuel rods and between the fuel rods and the fuel tube (PWR) or the fuel channel (BWR). A typical PWR fuel assembly finite element model is shown in Figure 4.4-8, which corresponds to the 14×14 fuel assembly. The BWR fuel assembly model only considers the region up to the inner surface of the channel, and a typical BWR fuel assembly is shown in Figure 4.4-9, which corresponds to the 10×10 fuel assembly.

The effective conductivity for the fuel is determined by using an equation defined in a Sandia National Laboratory Report [15]. The equation is used to determine the maximum temperature of a square cross-section of an isotropic homogeneous fuel with a uniform volumetric heat generation. At the boundary of the square cross-section, the temperature is constrained to be uniform. The expression for the temperature at the center of the fuel is given by:

$$T_c = T_e + 0.29468\ (Qa^2 / K_{eff})$$

where:

T_c	the temperature at the center of the fuel (°F)
T_e	the temperature applied to the exterior of the fuel (°F)
Q	volumetric heat generation rate (Btu/hr-in^3)
a	half length of the square cross-section of the fuel (inch)
K_{eff}	effective thermal conductivity for the isotropic homogeneous fuel (Btu/hr-in-°F)

Volumetric heat generation (Btu/hr-in^3) based on the design heat load is applied to the pellets. The effective conductivity is determined based on the heat generated and the temperature difference from the center of the model to the edge of the model. Temperature-dependent effective properties are established by performing multiple analyses using different boundary temperatures. The effective conductivity in the axial direction and the effective density of the fuel assembly are calculated on the basis of the material area ratio. The effective specific heat is computed on the basis of a weighted mass average.

For the PWR fuel assemblies, the 14×14 fuel assembly is shown to have the effective properties that correspond to the minimum values, as shown in Table 4.4-1 for both fuel tube configurations.

For the BWR fuel assemblies, the 10×10 fuel assembly is shown to have the effective properties that correspond to the minimum values, as shown in Table 4.4-2.

4.4.1.4 Two-Dimensional Neutron Absorber Models

The two-dimensional neutron absorber model is used to calculate the effective conductivities of the neutron absorber, the neutron absorber retainer, and the fuel channel (for BWR only). These effective conductivities are used in the two-dimensional fuel basket models (Section 4.4.1.2). A total of three neutron absorber models is required: one PWR model (for the PWR 14×14) and two BWR models—one with the neutron absorber plate and channel, and one with the channel but without the neutron absorber plate, corresponding to the enveloping configurations of the 10×10 BWR fuel assembly.

The configurations shown in the neutron absorber models in Figure 4.4-10 and Figure 4.4-11 for PWR and BWR fuel, respectively, incorporate the neutron absorber (and the channel for the BWR). The configuration shown in Figure 4.4-12 is for the BWR fuel tube with the channel, but without the neutron absorber.

As shown in Figure 4.4-10, the PWR fuel tube model includes the neutron absorber, the stainless steel retainer, and the gaps between the neutron absorber and the stainless steel retainer and the surface of the fuel tube. Three conditions of media are considered in the gaps: helium, vacuum and water.

ANSYS PLANE55 conduction elements and LINK31 radiation elements are used to construct the model. The model consists of four layers of conduction elements and two sets of radiation elements (radiation elements are not used for the water condition) that are defined at the gaps (two for each gap). The thickness of the model (x-direction) is the distance measured from the outside surface of the stainless steel retainer to the inside surface of the fuel tube (assuming the neutron absorber is centered between the retainer and the fuel tube, and there is no contact for the length of the basket). The gap size between the neutron absorber and the adjacent surfaces is 0.002 inch.

The BWR fuel assemblies may include a fuel channel, as compared to the PWR assemblies, which have no fuel channel. Therefore, two effective conductivity models are necessary for the BWR: one model with the neutron absorber plate (a total of six layers of materials) and a fuel

channel; and the other model with a fuel channel, but with a gap replacing the neutron absorber plate (a total of two layers of materials).

As shown in Figure 4.4-11, the first BWR neutron absorber model includes the fuel channel, the retainer, the neutron absorber and associated gaps. As shown in Figure 4.4-12, the second BWR neutron absorber model includes the fuel channel and the gap between the fuel channel and the fuel tube surface.

Heat flux is applied at the left side of the model (retainer for PWR model and fuel channel for BWR model), and the temperature at the right boundary of the model is specified. The heat flux is determined based on the design heat load. The maximum temperature of the model (at the left boundary) and the temperature difference (ΔT) across the model are calculated by the ANSYS model. The effective conductivity (K_{xx}) is determined using the following formula.

$$q = K_{xx} (A/L) \Delta T$$

or

$$K_{xx} = q \; L / (A \; \Delta T)$$

where:

K_{xx}	effective conductivity (Btu/hr-in-°F) in X direction in Figure 4.4-10 through Figure 4.4-12
q	heat rate (Btu/hr)
A	area (in^2)
L	length (thickness) of model (in)
ΔT	temperature difference across the model (°F)

The temperature-dependent conductivity is determined by varying the temperature constraints at one boundary of the model and solving for the temperature difference. The effective conductivity for the parallel path (the Y direction in Figure 4.4-10) is calculated by the following.

$$K_{yy} = \frac{\sum K_i \, t_i}{L}$$

where:

K_i	thermal conductivity of each layer (Btu/hr-in-°F)
t_i	thickness of each layer (in)
L	total length (thickness) of the model (in)

4.4.1.5 Two-Dimensional Transfer Cask and TSC Model

During the transfer condition, the TSC in the transfer cask is subjected to four separate conditions.

- The water phase when the lid is being welded to the TSC.
- The drying phase in which pressurized helium drying or vacuum drying can be used to remove moisture from the TSC.
- The helium backfilled phase when the TSC closure is completed and the transfer cask annulus flow system is operating.
- The operation of loading the helium-backfilled TSC into the concrete cask without the transfer cask annulus flow system operating.

Except for the final operation of placing the TSC into the concrete cask, the first three steps are considered to be steady-state conditions, if pressurized helium drying is used to remove the moisture. For vacuum drying operations, the time in vacuum drying is administratively controlled to maintain the maximum fuel cladding temperatures less than the allowable temperature. During the operational sequence of TSC loading, an annulus cooling system may be used to flow water through the annulus to cool and maintain a specified temperature for the TSC external shell. Alternative cooling methods, including TSC preparations on a pool shelf partially submerged or placement in an equivalent immersion method, may also be used. The MAGNASTOR system may also be prepared without annulus cooling methods, although the allowable preparation times are reduced. The annulus cooling methods, when used, are designed to accommodate design basis heat loads without additional heat rejection from the transfer cask to the environment.

Evaluation of the Water Phase

The model that includes water in the TSC treats the entire cavity as though it is filled with water. Since it is necessary to remove some water from the TSC during the closure lid welding operation, the water level in the TSC may be below the top of the fuel basket. The fuel tubes are designed with holes in the sides to permit the water to flow from the center of the TSC to the downcomer region of the TSC. The two-dimensional axisymmetric transfer cask and TSC model is used to evaluate the transfer operation for PWR fuel with a heat load of 40 kW, which bounds the design basis heat load of 35.5 kW. Since the PWR fuel heat load and calculated temperatures in the steady-state condition bound those for the BWR fuel, the bounding configuration is considered to be the TSC containing a design basis PWR fuel heat load. The components comprising the transfer cask and TSC model are shown in Figure 4.4-13. The TSC portion of the model is identical to the model employed in Section 4.4.1.1, with the exception that one of the

conditions in the transfer operations uses water in the TSC instead of helium. The model for the TSC, described in Section 4.4.1.1, uses effective properties for the fuel basket region. For the water condition, the methodology described in Sections 4.4.1.2, 4.4.1.3, and 4.4.1.4 is used to determine the effective properties for the fuel basket region. For the condition of water in the TSC, no contribution due to radiation was considered; only conduction was taken into account for the effective properties. The porous media constants for the fuel basket region need not be recomputed since they are dependent on the fuel assembly and fuel basket geometry only. However, during the analytical evaluation of the water phase, the pressure drop in the fuel basket region due to the water requires the use of the viscosity, which is input as a material property. Since the maximum water temperature in the TSC is significantly below 212°F, the water is expected to remain in the liquid state, and the use of properties for the liquid state is acceptable. The transfer cask and the water annulus between the transfer cask and the TSC are also included in the model. The transfer cask inner shell is represented by effective properties. The model also contains the shield doors of the transfer cask. While the inlets to the transfer cask are tubes in the side walls of the transfer cask, they are included in the model as straight sections parallel to the annulus. The following conditions are applied to the model for the steady-state evaluation of the water condition.

- The outer surfaces of the transfer cask are considered to be adiabatic and without the application of solar insolance.
- The inlet water temperature for the annulus between the TSC and the transfer cask is specified to be 125°F.
- The driving force for the water flow in the annulus between the TSC and the transfer cask is natural convection.
- The heat generation internal to the TSC is conservatively modeled as 40 kW. Regions A, B and C, as defined in Figure 4.1-1, are comprised of fuel assemblies with heat loads of 1.08 kW, 1.35 kW and 0.88 kW, respectively.
- The flow in the TSC and in the annulus region is treated as being laminar for both the water and helium conditions of the TSC.
- Radiation heat transfer is removed from the solution.

Evaluation of the Drying Phase-Pressurized Helium Drying System

The TSC can be dried of residual moisture following draining by either pressurized helium drying or vacuum drying methods. A Pressurized Helium Drying (PHD) System is used to force pressurized helium to circulate through the TSC. The PHD system flows dry helium entering through the drain tube to the bottom of the TSC, with the moist and heated helium exiting from the vent port. The circulation of the helium in the TSC during this time will result in helium flowing up through the fuel assemblies. The pressure employed in the system for the drying and

recirculation of the helium will result in the helium mass flowing up through the fuel region in the same manner as it does during the normal conditions of storage. For this reason, the two-dimensional FLUENT model and the properties developed for the storage condition are also applied for the condition of the drying phase using pressurized helium. Since the water in the annulus will normally maintain the TSC shell temperatures to be less than 180°F, the temperatures for the fuel region will be significantly less than those determined for normal conditions of storage. The following conditions are applied to the model for the steady-state evaluation of the drying condition.

- The outer surfaces of the transfer cask are considered to be adiabatic and without the application of solar insolance.
- The inlet water temperature for the annulus between the TSC and the transfer cask is specified to be 125°F.
- The driving force for the water flow in the annulus between the TSC and the transfer cask is natural convection.
- The heat generation internal to the TSC is conservatively modeled as 40 kW. Regions A, B and C, as defined in Figure 4.1-1, are comprised of fuel assemblies with heat loads of 1.08 kW, 1.35 kW and 0.88 kW, respectively. This evaluation bounds the current design basis condition for PWR fuel of 35.5 kW and 33 kW for BWR contents.
- The flow in the TSC and in the annulus region is treated as being laminar for both the water and helium conditions of the TSC.
- Radiation heat transfer is included in the solution.

Evaluation of the Drying Phase-Vacuum Drying System

Alternatively, a Vacuum Drying System (VDS) may be used to evacuate and dry the TSC cavity by vaporization and removal of the water vapor and other gases from the cavity through the vent and drain port openings. Only the PWR system is evaluated herein since it is considered to bound the BWR system in terms of providing bounding temperatures for a specific time in vacuum for the same total heat load of the basket, as summarized in the following discussion. In a vacuum condition, the only mode of heat transfer from the fuel assembly to the basket is by radiation. While axial conduction provides some mitigation of the peaking effect, the analysis in this section conservatively considers only radial heat transfer from the basket to the canister. Additionally, no contact between the basket and the fuel and the neutron absorber is assumed to exist. The presence of more fuel rods in a fuel assembly only serves to provide increased interference to reduce the effective thermal conductivity of the fuel assembly. In conjunction with the lower conductivity, the temperature increase from the edge of the PWR fuel assembly to the center of the PWR fuel assembly is expected to be significantly larger than the corresponding increase for the BWR fuel assembly. The expression for the fuel temperature change ($\Delta T = T_c - T_c$)

in Section 4.4.1.3 is in terms of the volumetric heat generation, the area of the region and the conductivity. Since the active fuel lengths are considered to be the same for BWR and PWR, the ΔT is proportional to the total heat of the fuel assembly. The peak clad temperatures are expected to be largest at the center of the basket in which the maximum PWR fuel assembly heat is 959 W in a uniform loading configuration. This indicates that the ΔT for the PWR would be more than a factor of two (922 W/ 379 W > 2) greater than the ΔT for the BWR, without considering the additional increase due to the lower conductivity of the PWR fuel assembly. It is also noted that the total basket heat load of the PWR fuel assembly bounds that of the BWR.

The transfer cask model used for the thermal transient analysis is comprised of a three-dimensional ANSYS model as shown in Figure 4.4-16. Figure 4.4-17 shows further details of the model with respect to the fuel tubes, the fuel and the neutron absorber. The model does not contain the canister lid and bottom and, conservatively, neglects any heat being rejected in the axial direction. During the vacuum drying phase, the annulus cooling system, or alternative methods, is normally operational and allows the heat from the canister to be rejected in the same manner as for the water phase. The transfer annulus cooling system is considered to be an operational convenience since the transfer cask can be placed back into the spent fuel pool at any point in time during the transfer operation without resulting in thermal shock to the transfer cask system. A constant temperature of 160°F is applied to the canister surface, which is the maximum temperature of the annulus cooling system water exiting the transfer cask.

Effective properties for the fuel region and the neutron absorber corresponding to the vacuum condition are employed, and they are described in Sections 4.4.1.3 and 4.4.1.4, respectively. This model is used to determine the allowable time in vacuum, depending on the heat load, to ensure that the fuel cladding temperature limit of 752°F (400°C) is not exceeded. If additional vacuum drying is required to meet the specified cavity dryness criteria, additional drying cycles can be performed following 12 hours of cooling the TSC, either with the annulus cooling system or returning the transfer cask and TSC to the spent fuel pool. TSC cooling is facilitated by backfilling the TSC cavity with helium to a pressure of 7 atmospheres (gauge). The backfilled helium will establish a convective heat transfer flow regime, thereby reducing the fuel cladding and system component temperatures.

A separate transient analysis is required to determine the maximum system temperature immediately after the backfilled helium condition. The transient analysis is performed in two steps using the same two-dimensional FLUENT model employed in the water phase condition, with the exception of altering the properties and boundary conditions. The initial step of the transient evaluation to simulate the helium backfill condition is to specify an initial temperature

of the canister and its contents. This is accomplished by first solving a steady-state problem using effective thermal properties based on the vacuum condition. A heat load of 12 kW was employed for this steady-state condition, which would establish a maximum temperature of 752°F. This temperature bounds maximum temperatures to be obtained during the vacuum drying. It also bounds the maximum energy stored in the fuel prior to being rejected during the helium-backfilled condition. Once this temperature field is determined, it is applied to the same FLUENT model with the properties being altered to simulate the helium-backfilled condition. The helium pressure used in the transient analysis for the backfill evaluation was conservatively specified to be 5 atm (gauge), as opposed to 7 atm (gauge) specified in the procedures. Lower pressure corresponds to lower density, which would minimize the heat rejection by convection internal to the canister. The fuel assemblies in the canister correspond to the uniform heat load. The design basis heat load provides bounding temperatures and minimum times for vacuum. For fuel with burnup higher than 45,000 MWd/MTU, the temperature change is limited to 117°F, and the time in cooling to 12 hours. With the identification of the temperature after the backfill condition, the time in vacuum for the additional cycles can be determined, since the temperature time history will follow the same time dependency as for the initial vacuum condition.

Evaluation of the Helium Phase

Following the completion of drying and final cavity evacuation (for vacuum drying only), the TSC is backfilled and pressurized with helium to establish the cavity atmosphere conditions for the normal condition of storage. The transfer cask and TSC remain in this helium phase condition until the TSC is placed into the concrete cask. During the helium phase, the transfer cask annulus cooling system will normally be in operation until the TSC preparations for transfer to the concrete cask are completed. Since the water in the annulus will maintain the TSC shell temperatures at less than 180°F, the temperatures for the fuel region will be significantly less than those determined for normal conditions of storage. The evaluation of this condition is required to determine the initial conditions for the operation in which the TSC is placed into the concrete cask with the transfer cask annulus flow system not in operation. Since the conditions are identical to those for the drying phase, an additional evaluation is not required. The results obtained for the evaluation of the drying phase are applicable for the helium phase.

Evaluation of Moving the TSC into the Concrete Cask

The transfer cask is used to load the TSC into the concrete cask. During this phase, there is no active auxiliary cooling of the transfer cask. Therefore, the annulus is filled with ambient air and this operation is time-limited, as natural convection cooling of the transfer cask is limited. The thermal performance of the transfer cask in this condition is similar to the concrete cask accident

event in which all of the air inlets are blocked. The TSC for this operational condition is identical, with one exception, to the condition of the TSC in the concrete cask for the condition of all air inlets blocked. The exception is that the initial fuel and TSC component temperatures for this operational condition are significantly lower than the design basis temperatures for the normal conditions of storage. While the concrete cask has significantly more mass to absorb heat than the transfer cask, the conductivity of the concrete is only approximately 4% of the conductivity of lead or carbon steel. Thus, the transfer cask has the ability to effectively absorb more heat than the concrete cask for a limited period of time. The transient solution for the concrete cask for the all air inlets blocked condition provides bounding fuel temperatures for this TSC transfer condition. The transient solution performed for the all inlets blocked condition can be used to identify a "temperature rate change," which establishes the time limit for moving the TSC into the concrete cask once the transfer cask annulus water cooling system has been shut off. During this TSC transfer condition, the duration of time to complete the movement and placement in the concrete cask will be limited to assure that the fuel temperatures remain less than 752°F (400°C).

4.4.2 Test Model

MAGNASTOR is conservatively designed by analysis. Therefore, no physical model is employed for thermal analysis. The benchmark provided in Section 4.8.1 provides confirmation that the analysis methodology employed for the MAGNASTOR design is conservative.

4.4.3 Maximum Temperatures for PWR and BWR Fuel Configurations

Normal Conditions of Storage

The temperature distribution and maximum component temperatures for MAGNASTOR for normal conditions of storage are provided in this section. System components containing PWR and BWR fuels are addressed separately. The temperature distributions for the BWR design basis fuel are similar to those of the PWR design basis fuel and are, therefore, not presented.

The temperature distribution for the concrete cask and the TSC containing the PWR design basis fuel for normal conditions of storage, with a uniform heat load, is shown in Figure 4.4-14. The air velocity distribution in the annulus between the TSC and the concrete cask liner for the normal conditions of storage for PWR fuel is shown in Figure 4.4-15. The maximum component temperatures for the normal conditions of storage for the PWR and BWR design basis fuel are shown in Table 4.4-3. It is noted that the thermal performance of MAGNASTOR provides

significant thermal margins with the conservative ambient design basis temperature defined approximately 24°F higher than any existing ISFSI site in the United States.

As shown in Figure 4.4-14, the peak fuel temperature for the normal storage condition occurs near the top of the fuel basket and, based on the uniform spacing of the isotherms at the centerline of the TSC, the temperature varies monotonically from the TSC bottom to the peak near the top of the fuel basket. This is indicative that the dominant mode of heat rejection from the fuel is by convection due to the helium flow circulating within the TSC.

The calculated temperatures at the TSC surface for the normal storage condition are higher than the concrete liner or surface, indicating that radiation heat transfer occurs across the concrete TSC cask annulus. As shown in Table 4.4-3, the maximum local temperature in the concrete can reach 270°F for PWR design basis fuel, which is less than the 300°F allowable temperature.

Transfer Condition

The maximum component temperatures for MAGNASTOR during the transfer operation are reported in this section. Since the PWR fuel configuration is considered to be bounding, it is conservative to identify these temperature results for the PWR fuel design basis heat load as the maximum temperatures for the BWR fuel design basis heat load. The transfer operation is comprised of four separate phases: the water phase, the drying phase, the helium phase, and the TSC loading phase. The only phases considered to be limited by time are vacuum drying of the TSC and the final phase of loading the TSC into the concrete cask. The reason that indefinite time limits are permitted for the water phase, the helium drying phase, and the helium phase is the normal use of the transfer cask annulus cooling water system, partially submerged loading conditions, or equivalent immersion system. The transfer annulus cooling system is considered to be an operational convenience since the transfer cask can be placed back into the spent fuel pool at any point in time during the transfer operation without resulting in thermal shock to the transfer cask system. The annulus cooling water system (or the alternative cooling methods) maintains the canister shell at a temperature significantly lower than the temperature corresponding to the normal conditions of storage. The maximum temperature for the PWR fuel cladding is reported for each of the separate transfer phases in Table 4.4-4. It is observed that the PWR fuel cladding temperatures shown in Table 4.4-4 are bounded by the PWR fuel cladding temperatures for the normal storage steady-state conditions in Table 4.4-3. This indicates that the normal condition PWR fuel cladding and component temperatures, such as for the fuel basket and the TSC, bound the maximum temperatures for any phase of the transfer condition for the fuel basket and TSC components. The times for the vacuum drying are administratively controlled to maintain the fuel cladding temperature below the 752°F limit. The TSC loading

phase is administratively limited to 36 hours to ensure that the maximum fuel cladding temperature is bounded by the normal condition storage temperature. The 36 hours is determined using the fuel cladding temperature rise for the "all air inlets blocked" accident event and the peak fuel cladding temperature limit of 752°F.

The off-normal condition for use of the annulus cooling system corresponds to loss of cooling by the annulus cooling system. This can occur during the water phase or the drying phase of transfer operations. If loss of cooling occurs during the water phase, a conservative energy balance treating the canister surface as being adiabatic shows that the canister temperature can be maintained for 7 hours without exceeding 212°F. If the water phase exceeds this time limit, the cask is to be returned to the spent fuel pool. In the event the loss of cooling occurs during the drying phase using vacuum drying, the canister is first backfilled with helium. Using the transient evaluation in Section 4.4.1.5 for the transfer cask model, it is determined that a time of 11 hours is permitted to return the annulus cooling system to service or return the canister to the pool. The condition of the loss of annulus cooling for the option of the pressurized helium drying system is bounded by the loss of cooling occurring during the vacuum drying phase.

The loading procedures in Chapter 9 provide operational sequence alternatives and time limitations if the annulus cooling system is not operating. In all cases, the final corrective action is to backfill the TSC with helium to 7 atm gauge pressure and return the system to the spent fuel pool. These operational sequences, time limits and corrective actions will ensure that the fuel cladding and system component temperatures do not exceed design allowable values.

4.4.4 Maximum Internal Pressures for PWR and BWR TSCs

The maximum TSC internal operating pressures for normal conditions of storage are calculated in the following sections for the TSCs containing PWR and BWR design basis fuel assemblies.

Maximum Internal Pressure for the TSC Containing PWR Fuel

The internal pressure of a TSC containing PWR fuel assemblies is a function of fuel type, burnup, initial enrichment, cool time, fuel condition (failure fraction), presence or absence of nonfuel hardware, TSC length, and the backfill gases in the TSC. Gases included in the pressure evaluation of a TSC containing PWR fuel include fuel rod fission, decay and backfill gases, gas generated by the nonfuel hardware components (assembly control components contain boron as the absorber material), and TSC backfill gases. Each of the PWR fuel types is separately evaluated to determine a bounding pressure for a TSC containing PWR fuel assemblies.

Fission gases include all fuel material generated gases, including helium generated by long-term actinide decay. Based on detailed SAS2H calculations, the quantity of fission and decay gases rises as burnup and cool time are increased and enrichment is decreased. The maximum gas available for release is conservatively calculated based on 70,000 MWd/MTU burnup cases at an enrichment of 1.9 wt % ^{235}U and a cool time of 40 years for maximum fissile material assemblies in each major PWR fuel class. For other PWR fuel assembly types, fission and decay gases are determined by ratioing the fissile material mass to the maximum fissile material mass assemblies.

Fuel rod backfill pressure varies significantly among the PWR fuel types. Based on a literature review, a 500 psig backfill is assigned to Westinghouse and CE core fuel types. A maximum backfill pressure of 435 psig is assigned to B&W core assemblies. Backfill gas quantities are based on the fresh fuel free volume between the fuel pellet stack and the fuel rod cladding, including the plenum volume, and a backfill temperature of 68°F.

Burnable poison rod assemblies (BPRAs) placed within the TSC may contribute additional gas quantities due to n-alpha reaction of ^{10}B during in-core operation. A portion of the neutron poison population is formed by ^{10}B. Other neutron poisons, such as gadolinium and erbium, do not produce a significant amount of helium nuclides (alpha particles). The principal BPRAs in use include the Westinghouse Pyrex (borosilicate glass) and WABA (wet annular burnable absorber) configurations, as well as B&W BPRAs and shim rods used in CE cores. The CE shim rods replace standard fuel rods to form a complete assembly array. The quantity of helium available for release from the BPRAs is directly related to the initial boron content of the fuel rods and the release fraction of gas from the matrix material. The gas released from either of the

Figure 4.4-1 Two-Dimensional Model of Concrete Cask Loaded with PWR TSC

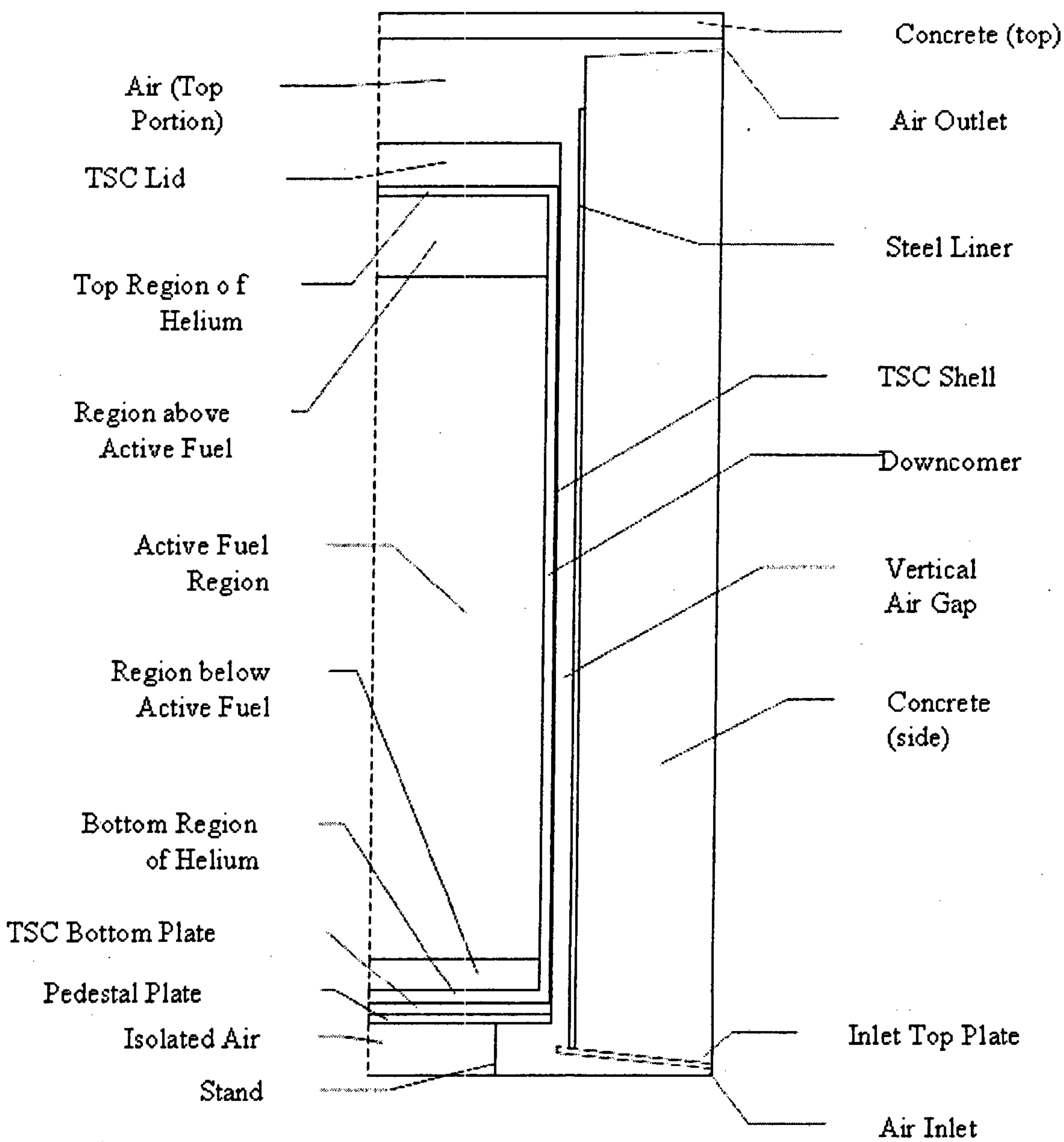


Figure 4.4-2 Computational Mesh for the Two-Dimensional Axisymmetric CFD Model of the Concrete Cask

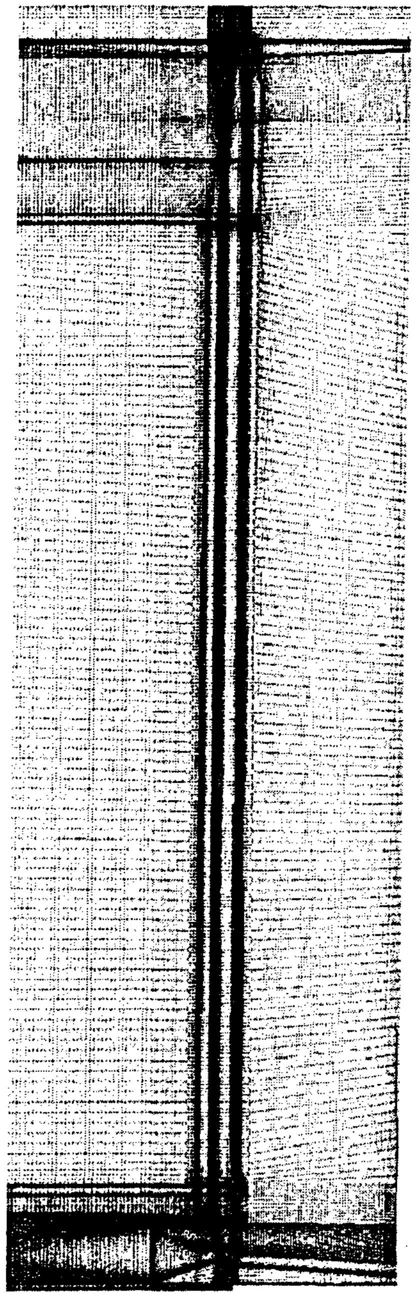


Figure 4.4-5 PWR Peak Fuel Cladding Temperature versus TSC Internal Pressure

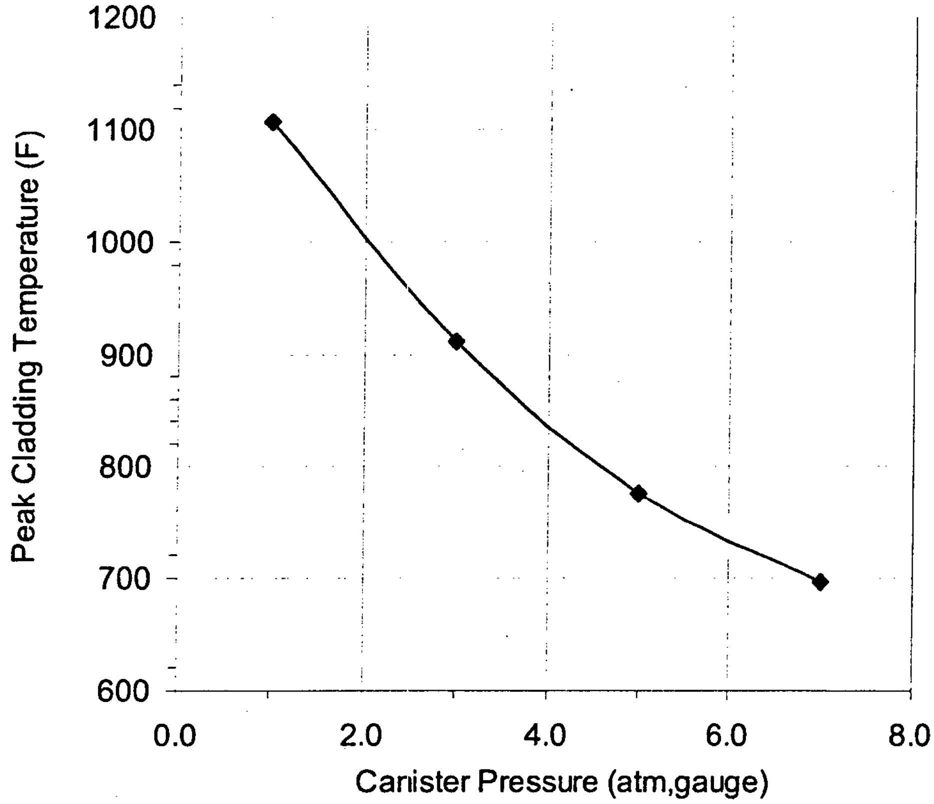


Figure 4.4-6 Two-Dimensional Finite Element Model of the PWR Fuel Basket

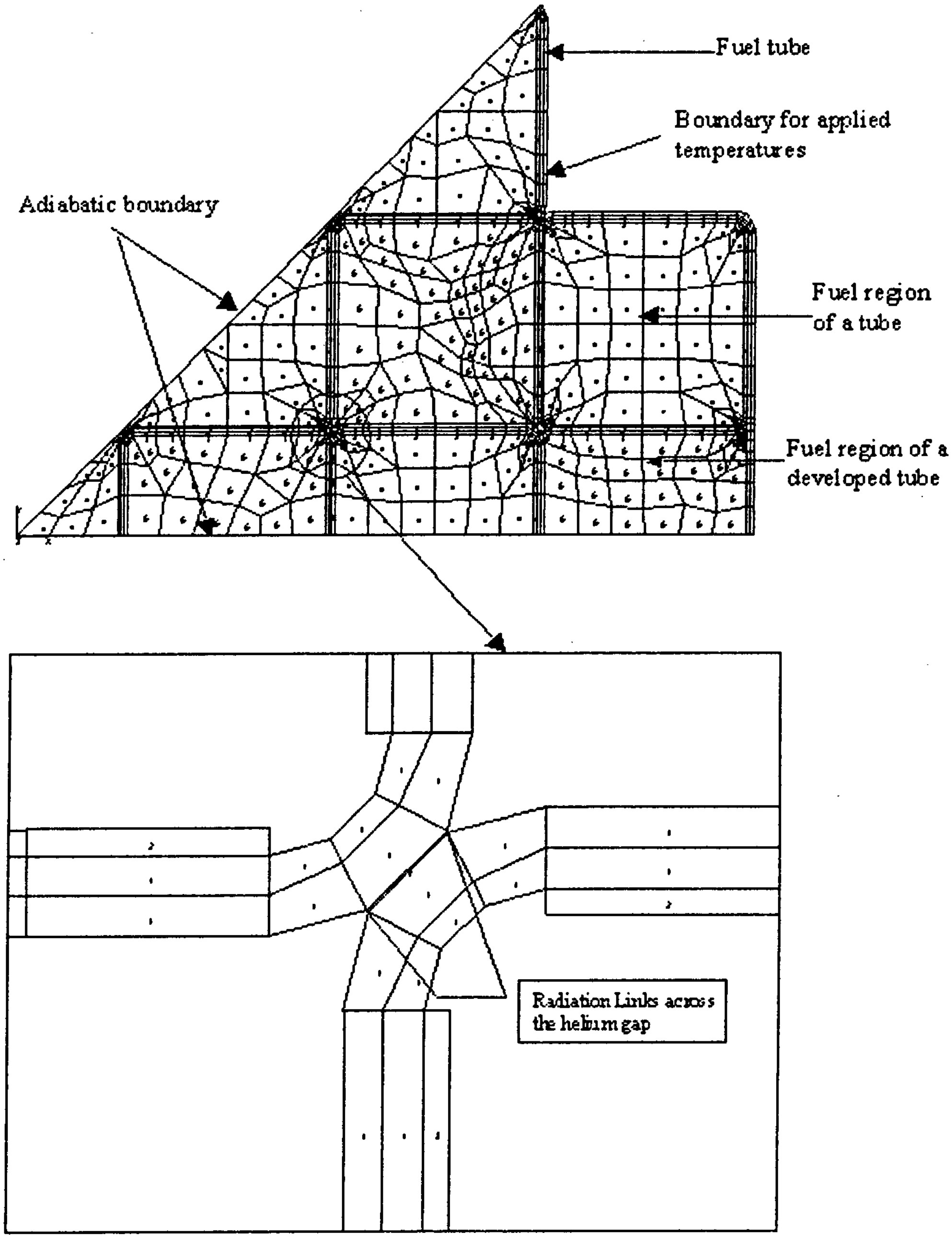


Figure 4.4-13 Two-Dimensional Model of Transfer Cask Loaded with a PWR TSC

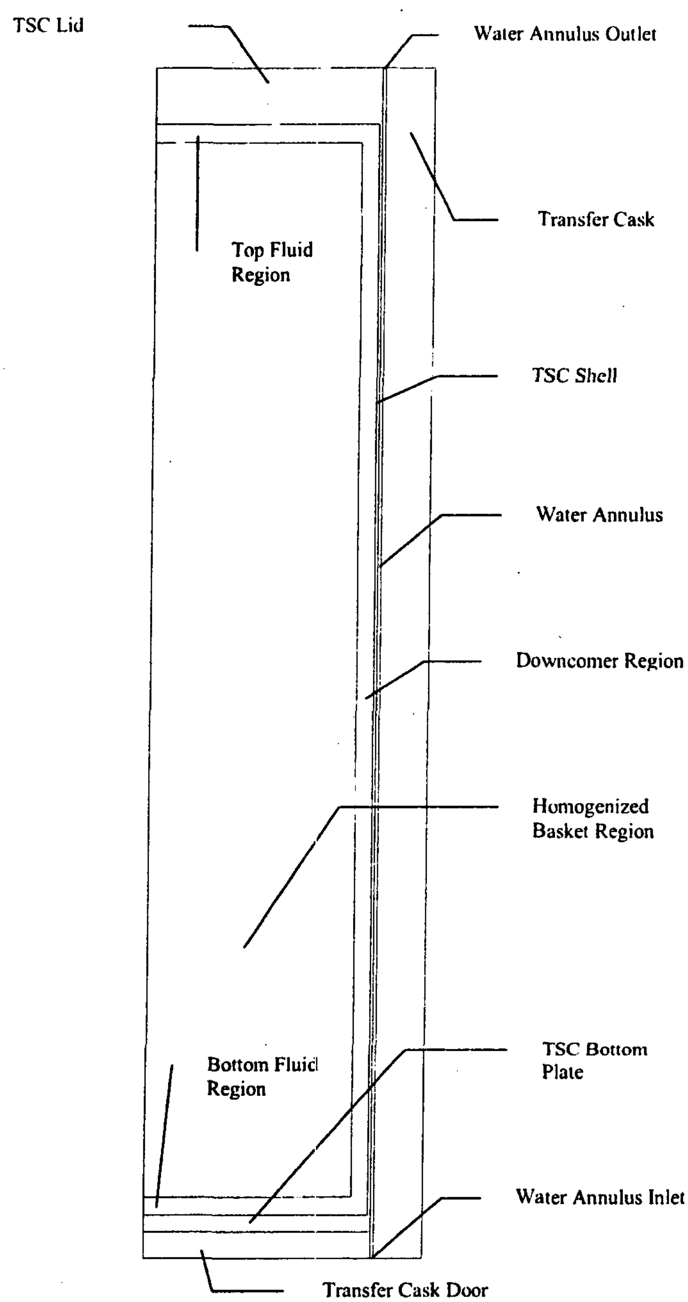


Figure 4.4-14 Temperature (°F) Distribution for the Concrete Cask and TSC Containing a Design Basis PWR Heat Load

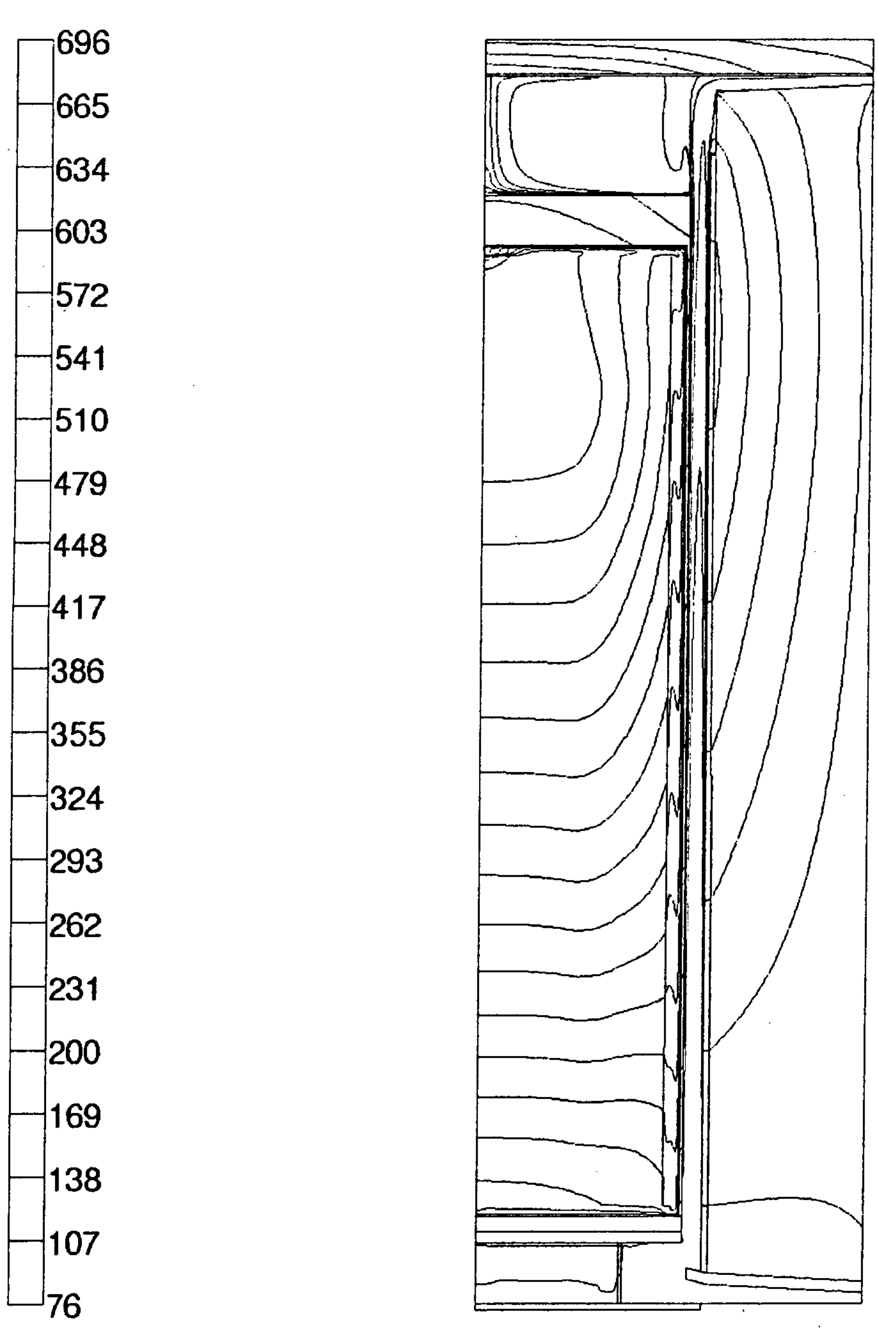


Figure 4.4-15 Air Velocity (m/s) in the Concrete Cask Annulus for the Design Basis PWR Heat Load

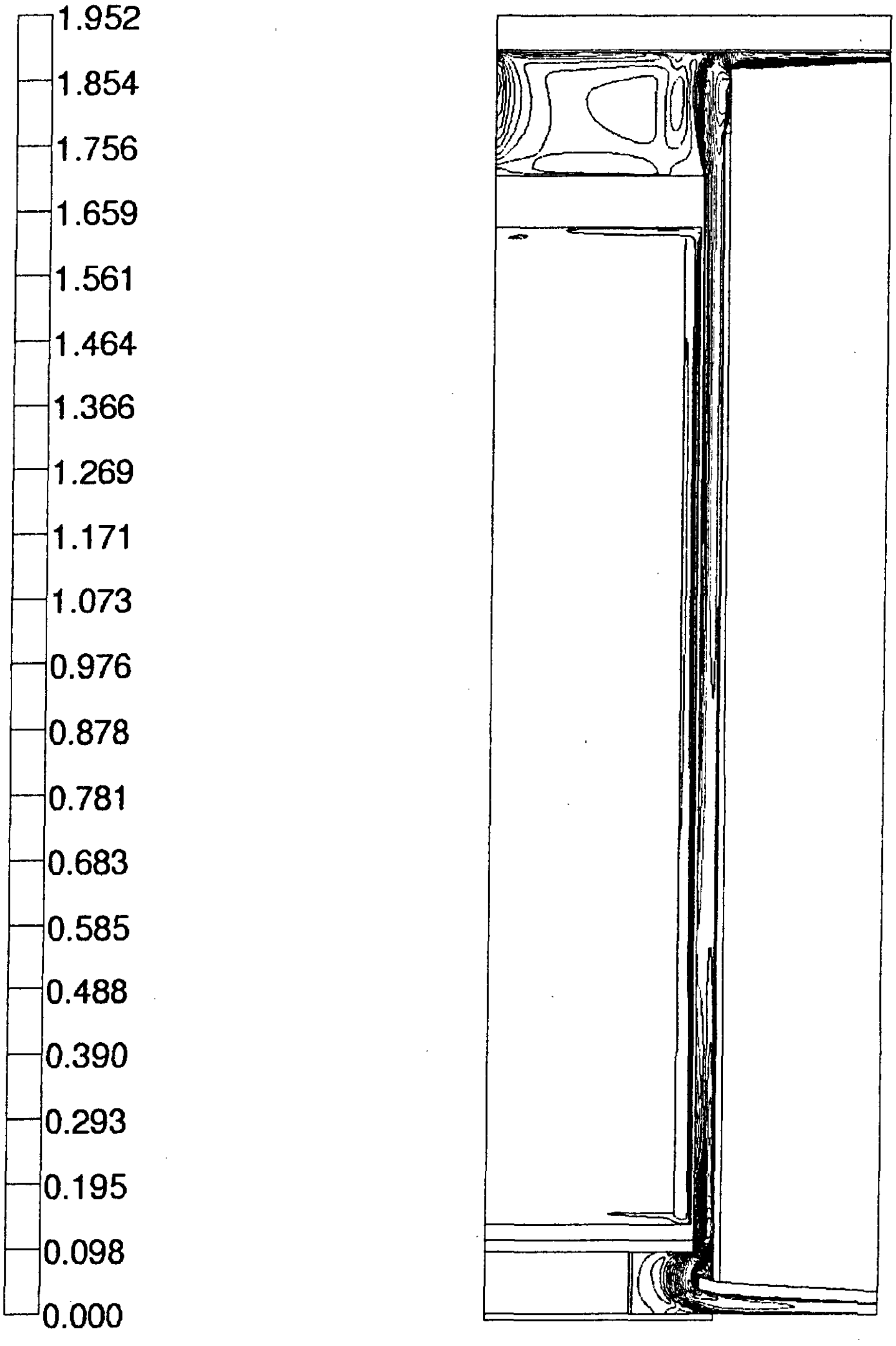


Figure 4.4-16 Three Dimensional ANSYS Model of the PWR Canister Vacuum Condition

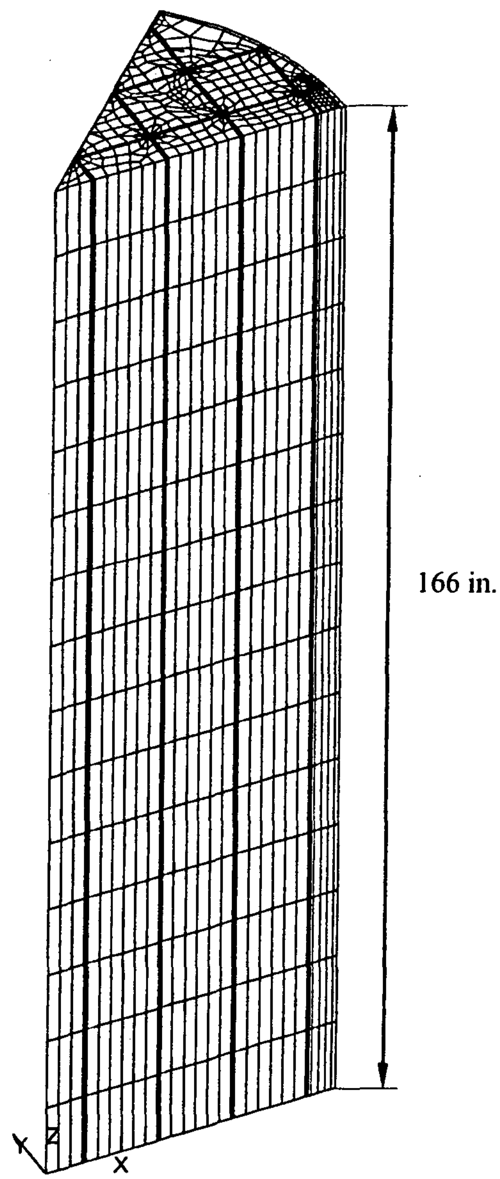


Table 4.4-3 Maximum Component Temperatures for Normal Condition Storage of Design Basis PWR and BWR Heat Loads

Component	PWR	BWR	Allowable Temperature (°F)
Fuel Cladding	696	665	752
Fuel Basket [a]	696	665	700
TSC Shell	455	429	800
Concrete	270 (local)	242 (local)	300 (local)
	160 (bulk)	153 (bulk)	200 (bulk)

Table 4.4-4 Maximum Fuel Temperatures for the Transfer Operations for Design Basis Heat Load

Transfer Phase	Maximum Fuel Cladding Temperature (°F)
Water	157
Pressurized Drying	514
Helium	514
TSC Loading into Concrete Cask	690
Vacuum	715

Table 4.4-5 Helium Mass Per Unit Volume for MAGNASTOR TSCs

Fuel Type	Helium Density (g/liter)
PWR	0.763
BWR	0.774

[a] The maximum fuel cladding temperature is conservatively used.

4.5 Off-Normal Storage Events

This section evaluates postulated off-normal storage events that might occur once during any calendar year of operation. The actual occurrence of any of these events is, therefore, infrequent.

The concrete cask and TSC model described in Section 4.4.1.1 is used for the evaluation of the concrete cask and TSC for the off-normal events: severe ambient temperature conditions (106°F and -40°F) and the half-blocked air inlets condition. The evaluation of the off-normal events for variations in the ambient temperature only requires a change to the boundary condition temperature. For the half-blocked air inlets condition, the air inlet condition is modified to permit only half of the air flow into the inlet. The design basis heat loads of 35.5 kW and 33 kW are used in the evaluations of the concrete cask and TSC containing PWR and BWR fuels, respectively.

The principal component temperatures for each of the off-normal events, discussed previously, are summarized in the following tables, along with the allowable temperatures. Note that the maximum fuel cladding temperatures are conservatively used as the maximum fuel basket temperatures. As the tables show, the component temperatures for the concrete cask and TSC containing PWR and BWR fuels are within the allowable values for the off-normal storage events.

Principal Component Temperatures – Off-Normal Storage of PWR Fuel

Component	106°F Ambient, Maximum Temperatures (°F)	-40°F Ambient, Maximum Temperatures (°F)	76°F Ambient/Half Blocked Air Inlets Temperatures (°F)	Allowable Temperature (°F)
Fuel Cladding	733	585	699	1,058
Fuel Basket	733	585	699	1,000
TSC Shell	483	334	457	800
Concrete	310	87	273	350

Principal Component Temperatures – Off-Normal Storage of BWR Fuel

Component	106°F Ambient, Maximum Temperatures (°F)	-40°F Ambient, Maximum Temperatures (°F)	76°F Ambient/Half Blocked Air Inlets Temperatures (°F)	Allowable Temperature (°F)
Fuel Cladding	701	551	667	1,058
Fuel Basket	701	551	667	1,000
TSC Shell	457	309	431	800
Concrete	281	62	245	350

There are no adverse consequences due to these off-normal events. The maximum component temperatures are less than the allowable temperature limits.

Off- Normal Event TSC Internal Pressures

Off-normal event TSC internal pressures are evaluated using the method and inputs documented in the normal condition pressure evaluations (Section 4.4.4). The off-normal event TSC internal pressure analysis considers a 10% rod failure fraction and a TSC backfill temperature at 491°F and a pressure of 104 psig. The higher backfill temperature, and associated pressure, is the result of the "severe heat" off-normal thermal evaluation. The maximum TSC internal pressures calculated for off-normal events are 114 psig for the PWR system and 110 psig for the BWR system.

4.6 Accident Events

This section presents the evaluations of the thermal accident design events, which address very low probability events that might occur once during the lifetime of the ISFSI or hypothetical events that are postulated because their consequences may result in the maximum potential impact on the surrounding environment. Three thermal accident events are evaluated in this section: maximum anticipated heat load, fire accident and full blockage of the air inlets. The maximum TSC internal pressure for the bounding accident conditions is evaluated in Section 4.6.4.

The concrete cask and TSC model described in Section 4.4.1.1 is used for the evaluation of the concrete cask and TSC for these thermal accident events.

4.6.1 Analysis of Maximum Anticipated Heat Load

This section evaluates the concrete cask and the TSC for the postulated accident event of an ambient temperature of 133°F. A steady state condition is considered in the thermal evaluation of the system for this accident event.

Using the same methods and thermal models described in Section 4.4.1.1 for the normal conditions of storage, thermal evaluations are performed for the concrete cask and the TSC with its contents for this accident condition. All boundary conditions in the model are the same as those used for the normal condition evaluation, except that an ambient temperature of 133°F is used. The maximum calculated temperatures of the principal PWR and BWR cask component, with the corresponding allowable temperatures, are as follows.

Component	PWR Maximum Temp (°F)	BWR Maximum Temp (°F)	Allowable Temp. (°F)
Fuel Cladding	766	734	1,058
Fuel Basket	766	734	1,000
TSC Shell	508	482	800
Concrete	346	316	350

Note that the maximum fuel cladding temperatures are conservatively considered to be the maximum basket temperatures. This evaluation shows that the component temperatures are within the allowable temperatures for the extreme ambient temperature conditions.

4.6.2 Fire Accident

A fire may be caused by flammable material or by a transport vehicle. While it is possible that a transport vehicle could cause a fire while transferring a loaded storage cask at the ISFSI, this fire

will be confined to the vehicle and will be rapidly extinguished by the persons performing the transfer operations or by the site fire crew. Fuel in the fuel tanks of the concrete cask transport vehicle and/or prime mover (maximum 50 gallons) is the only flammable liquid that could be near a concrete cask, and potentially at, or above, the elevation of the surface on which the cask is supported. The fuel carried by other onsite vehicles or by other equipment used for ISFSI operations and maintenance, such as air compressors or electrical generators, is considered not to be within the proximity of a loaded cask on the ISFSI pad. Site-specific analysis of fire hazards will evaluate the specific equipment used at the ISFSI and determine any additional controls required.

The analyzed area is a 15×15-foot square, less the 136 in-diameter footprint of the concrete cask, corresponding to the center-to-center distance of the concrete casks on the ISFSI pad. The potential depth (D) of the 50-gallon pool of flammable liquid is calculated as follows.

$$D = \frac{50 \times 231}{15 \times 15 \times 144 - 3.14 \times 128^2 / 4} = 0.6 \text{ in.}$$

With a burning rate of 5 in/hr, the fire would continue for 7.2 minutes. The fire accident evaluation in this section conservatively considers an 8-minute fire. The temperature of the fire is taken to be 1,475°F, which is specified for the fire accident event in 10 CFR 71.73c [3].

The fire condition is an accident event and is initiated with the concrete cask in a normal operating steady-state condition. To determine the maximum temperatures of the concrete cask components, the two-dimensional axisymmetric model of the concrete cask and TSC for the PWR configuration described in Section 4.4.1.1 is used to perform a transient analysis. The PWR configuration is considered to bound the BWR configuration due to the higher initial temperatures of the normal condition.

The initial condition of the fire accident transient analysis is based on the steady-state analysis results for the normal condition of storage, which corresponds to an ambient temperature of 100°F in conjunction with solar insolation (as specified in Section 4.4.1.1). The fire condition is implemented by applying a boundary temperature condition of 1,475°F at the air inlet and the lower surface of the steel plate forming the top of the air inlet for eight minutes. This boundary condition temperature is applied as a stepped boundary condition. During the eight-minute fire, solar insolation is also applied to the outer surface of the concrete cask. At the end of the eight minutes, the temperature at the inlet is reset to the ambient temperature of 100°F. The cooldown phase is continued for an additional 10.7 hours to observe the maximum TSC shell temperature and the average temperature of the TSC contents.

4.7 References

1. 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High Level Radioactive Waste and Reactor-Related Greater than Class C Waste," Code of Federal Regulations, US Government, Washington, DC.
2. ISG-11, Revision 3 – "Cladding Considerations for the Transportation and Storage of Spent Fuel," US Nuclear Regulatory Commission, Washington, DC, November 17, 2003.
3. 10 CFR 71, "Packaging and Transportation of Radioactive Material," Code of Federal Regulations, US Government, Washington, DC.
4. ACI-349-85, "Code Requirement for Nuclear Safety Related Concrete Structures and Commentary," American Concrete Institute, Farmington Hills, MI.
5. PNL-4835, Johnson, A.B., and Gilbert, E.R., "Technical Basis for Storage of Zirconium-based alloy-Clad Fuel in Inert Gases," 1985.
6. "NS-4-FR Fire Resistant Neutron and/or Gamma Shielding Material" - Product Technical Data, The Japan Atomic Power Company, Tokyo, Japan.
7. Standard Handbook for Mechanical Engineers, Baumeister T. and Mark, L.S., 7th Edition, New York, McGraw-Hill Book Co., 1967.
8. ASME Boiler and Pressure Vessel Code, Section II, Part D, "Properties," American Society of Mechanical Engineers, New York, NY, 2001 Edition with 2003 Addenda.
9. ARMCO Product Data Bulletin No. S-22, "17-4PH, Precipitation Hardening Stainless Steel," ARMCO, Inc., 1988.
10. ASME Code Case N-71-17, "ASME Boiler and Pressure Vessel Code, Code Cases - Boilers and Pressure Vessels," American Society of Mechanical Engineers, New York, NY, 1996.
11. ANSYS, Revision 6.0, ANSYS INC, Canonsburg, PA
12. FLUENT, Revision 6.1, Fluent Inc, Lebanon, NH
13. "Principles of Heat Transfer," Krieth F., Bohn M.S., Fifth Edition, West Publishing Company.
14. "Fundamentals of Heat and Mass Transfer," F.P. Incropera and D.P. DeWitt, 1981.
15. "A Method for Determining the Spent-Fuel Contribution to Transport Cask Containment Requirements," TTC-1019, UC-820, Sandia 90-2406, Sanders, T. L., et al., November 1992.
16. EPRI NP-5128, "The TN-24P PWR Spent-Fuel Storage Cask: Testing and Analyses," Pacific Northwest Laboratory, Virginia Power Company and EG&G, Idaho National Engineering Laboratory, April 1987.
17. "A Physical Introduction to Fluid Mechanics," 1st Edition, Alexander J. Smits, 2000.
18. "Fluid Mechanics," 2nd Edition, Frank M. White, 1979.

19. "Annual Books for ASTM Standards," Section 1, Volume 01.04, American Society for Testing and Materials, West Conshohocken, PA.
20. "NUREG-1567, Standard Review Plan for Spent Fuel Dry Storage Facilities," US Nuclear Regulatory Commission, Washington, DC, March 2000.
21. EPRI TR-100305, "Performance Testing and Analyses of the VSC-17 Ventilated Concrete Cask," Pacific Northwest Laboratory, Virginia Power Company and EG&G, Idaho National Engineering Laboratory, May 1992.
22. "NUREG-1536, Standard Review Plan for Dry Cask Storage Systems", US Nuclear Regulatory Commission, Washington, DC January, 1997.
23. DOE/ET/47912-3, NAC-C-8129, "Domestic Light Water Reactor Fuel Design Evaluation," Volume III, September 1981.
24. DOE/RW-0184, Office of Civilian Radioactive Waste Management, "Characteristics of Spent Fuel, High-Level Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation," Volume 3, December 1987.

4.8.2 Methodology to Compute the Porous Media Constants

This section presents the methodology used to determine the porous media constants, which will simulate the flow resistance due to the fuel assembly and fuel assembly grids to be taken into account for the basket tube/fuel region of the two-dimensional axisymmetric TSC model.

To simulate the flow resistance in the porous media models, the following FLUENT porous media pressure drop [12] is employed.

$$\frac{\Delta P}{L} = \frac{\mu}{\alpha \varepsilon} V + C(\frac{1}{2} \rho V^2)$$

where:

ΔP/L	pressure drop per unit length (Pa/m)
V	superficial fluid velocity (m/s)
μ	the fluid viscosity (kg/m-s)
ρ	fluid density (kg/m^3)
α	permeability parameter (m^2)
C	inertial resistance factor (m^{-1})

In this representation, the pressure drop for the porous media consists of two terms: one being proportional to the velocity and the other proportional to the velocity squared. Since the velocities are on the order of 0.03 m/s in the porous media region, the contribution due to the V^2 term is neglected. The pressure drops for the fuel rods and the fuel assembly grids are taken into account in the first term. For the first term, the viscosity (μ) is obtained from the material properties defined for the gas, while the factor (α), referred to as the permeability, is computed on the basis of laminar flow. The purpose of this section is to determine an α for the BWR and the PWR fuel assemblies, which represents not only the resistance for the axial flow along the fuel rods, but also the additional resistance through the fuel assembly grids. The porous cells in the FLUENT program are 100% open in the porous media model [12]. Therefore, the factor for V must include the porosity factor with the values specified for 1/α. The input of 1/α into FLUENTis adjusted based on the porosity of the porous media [12]. The permeability for the BWR and the PWR fuel assemblies is determined separately. Separate models are considered for the spacing, size of the fuel rods, and the number of fuel rods in the PWR and the BWR fuel assemblies.

Permeability (α) for the PWR Fuel Assembly

For the PWR fuel assembly, the configuration that is considered to provide a bounding value for α is the 17×17 fuel assembly. The calculation for the 1/α for the entire PWR fuel assembly requires three FLUENT models. A quarter-symmetry model of the cross-section of the 17×17

fuel assembly is generated using FLUENT and the cross-section of the model is shown in Figure 4.8.2-1. The length of this fuel assembly model is 0.20 m in the axial direction, and consists of approximately 1.3 million cells. The purpose of this model is to determine the pressure drop per unit length $(\Delta P/L)_{ROD}$ along the fuel rod. For this reason, only the momentum equation is required to be solved. A velocity (U) for the gas entering the model is specified to be 0.03 m/s, which represents the velocity observed in the canister evaluation. Since the flow is considered to be laminar, the actual value used in the evaluation is not significant. Using the $\Delta P/L$ determined from the three-dimensional model, the $1/\alpha$ for the fuel rods is computed by

$$1/\alpha_{ROD} = (\Delta P/L)_{ROD} / (\mu U)$$

A second three-dimensional model is generated to determine the pressure drop of the gas through a 60 mm-long fuel assembly grid. A periodic model of a single cell is considered, which is shown in Figure 4.8.2-2, and consists of approximately 199,000 cells. The length of the model is 60 mm, which represents the full length of the 60 mm grid. The boundary conditions on the axial faces used in the fuel rod model are applied to each end of the periodic model of the fuel assembly grid. The model result is the determination of the average pressure at the outlet end of the grid, which is determined by computing the area averaged pressure acting on the outlet. This is used to compute the pressure drop per unit length $(\Delta P/L)_{GRID}$, which is used to compute the $1/\alpha_{GRID}$ for the fuel assembly grid by

$$1/\alpha_{GRID} = (\Delta P/L)_{GRID} / (\mu U)$$

Since the grid model is periodic, it simulates the condition in which the fuel assembly grid extends for the entire width of the basket slot region. This is not the geometry of the PWR fuel assembly grid in the basket, but rather there is a minimum of a 0.17-inch gap between the largest PWR fuel assembly and the smallest basket slot in the PWR basket. As the helium gas flows vertically up through the fuel rods, gas will not only flow through the fuel assembly grid, but also around the grid. To determine the distribution of the flow, a third three-dimensional quarter-symmetry FLUENT model consisting of approximately 332,500 cells is developed, as shown in Figure 4.8.2-3. A porous region with a length of 9.37 inches represents a section of fuel rods of 9.37 inches prior to the fuel assembly grid, and a section corresponding to a length of 9.37 inches is modeled after the fuel assembly grid. Both of these regions use the porous media constants determined for the bounding PWR fuel rod configuration. The bounding configuration was identified in two DOE reports ([23] and [24]) for the configuration with the largest combined grid length for all PWR assemblies. As shown in Figure 4.8.2-3, a nonporous gas region with a thickness of 0.17 inch is modeled in parallel with the region representing the fuel assembly grid. The porous media data for this model uses the results of the calculation of the porous media just for the fuel assembly grid. From the solution of the momentum equation, the

effective $1/\alpha_{EFF}$ corresponding to the pressure drop $(\Delta P/L)_{EFF}$ over the axial region containing the fuel assembly grid is computed using

$$1/\alpha_{EFF} = (\Delta P/L)_{EFF} / (\mu U)$$

The pressure drop is the difference between the averaged pressure on the outlet surface (area averaged) and the inlet, which is set to zero. To combine the permeabilities into a single quantity, the pressure drops over all the grids $[(\Delta P/L)_{EFF}]$ are added to the pressure drop $[(\Delta P/L)_{ROD}]$ over the remaining length of the fuel assembly (total fuel assembly length less the length of the fuel assembly grids) to calculate the total pressure drop due to fuel assembly grids and the fuel rods. Using an expression similar to the ones above, the $1/\alpha$ for the PWR fuel assembly is computed to be

$$1/\alpha_{PWR} = (\Delta P_{tot}/L_{tot}) / (\mu U) = 462{,}087 \text{ 1/m}^2$$

Permeability (α) for the BWR Fuel Assembly

For the BWR fuel assembly, the configuration that is considered to provide a bounding value for α is the 10×10 fuel assembly. The calculation for the $1/\alpha$ for the entire BWR fuel assembly requires two FLUENT models. A quarter-symmetry model of the fuel rods of the 10×10 fuel assembly was generated using FLUENT, and the cross section of the model is shown in Figure 4.8.2-4. The length of this fuel assembly model is 0.20 m in the axial direction, and consists of approximately 0.6 million cells. The walls of this model correspond to the BWR channel. This assumes that no helium gas flow is occurring between the BWR channel and the wall of the fuel tube. The model in Figure 4.8.2-4 does not contain any water tubes that are present in the BWR fuel assembly design. This is considered to be conservative since the cross-sectional area for flow is reduced by not considering gas flow through the water tubes.

This model is used to determine the pressure drop per unit length $(\Delta P/L)_{ROD}$ along the fuel rod, as was performed for the PWR fuel. A velocity (U) for the gas entering the model was specified to be 0.03 m/s, which represents the velocity observed in the canister evaluation. Since the flow is considered to be laminar, the actual value employed in the evaluation is not significant. Using the $\Delta P/L$ determined from the three dimensional model the $1/\alpha$ for the fuel rods is computed by

$$1/\alpha_{ROD} = (\Delta P/L)_{ROD} / (\mu U)$$

For the fuel assembly grid for the BWR, the pressure drop determined for the PWR fuel assembly grid was used. The evaluation of the effect of the grid for the PWR corresponds to a 17×17 fuel assembly which would inherently have more obstructions for flow as compared to a worst case 10×10 BWR fuel assembly. The pressure drop across the PWR fuel assembly grid is therefore considered to bound the pressure drop associated with the fuel assembly grid for the BWR design.

To combine the permeabilities into a single quantity, the pressure drop over multiple grids is computed. The bounding configuration was identified in references [23] and [24] for the configuration with the largest combined grid length for all BWR assemblies. The combined pressure drop was calculated by adding $((\Delta P/L)_{GRID})$ to the pressure drop $((\Delta P/L)_{ROD})$ over the remaining length of the fuel assembly (total fuel assembly length less the total length of the fuel assembly grids). The $1/\alpha$ for the entire BWR fuel assembly is computed to be

$$1/\alpha_{BWR} = (\Delta P_{tot}/L_{tot}) / (\mu \ U) = 566{,}550 \ \ 1/m^2$$

Figure 4.8.2-1 Cross-Sectional View of the Three-Dimensional Fluent Model of a 17×17 PWR Fuel Assembly

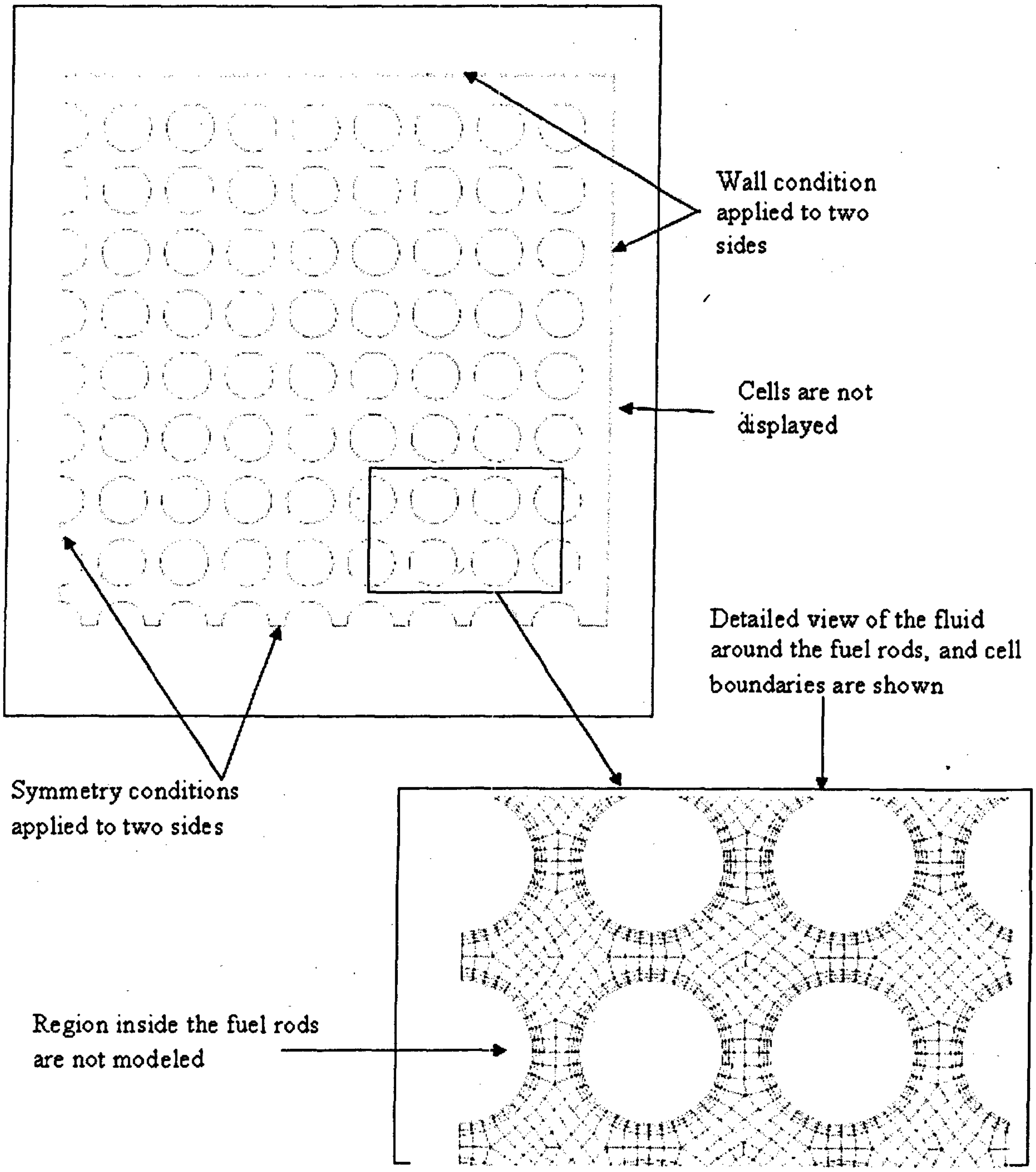


Figure 4.8.2-2 Three-Dimensional Fluent Model of a Fuel Assembly Grid

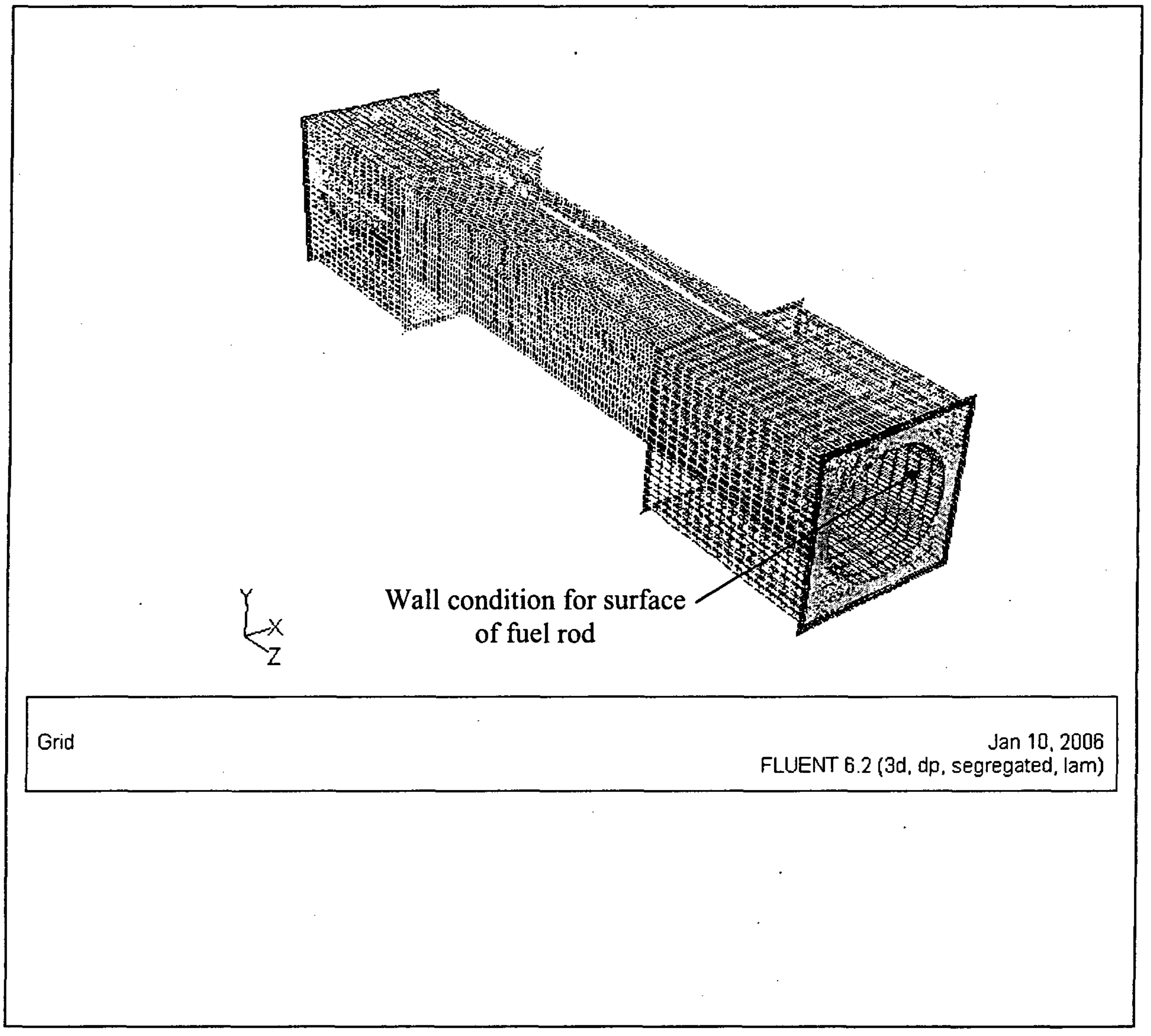
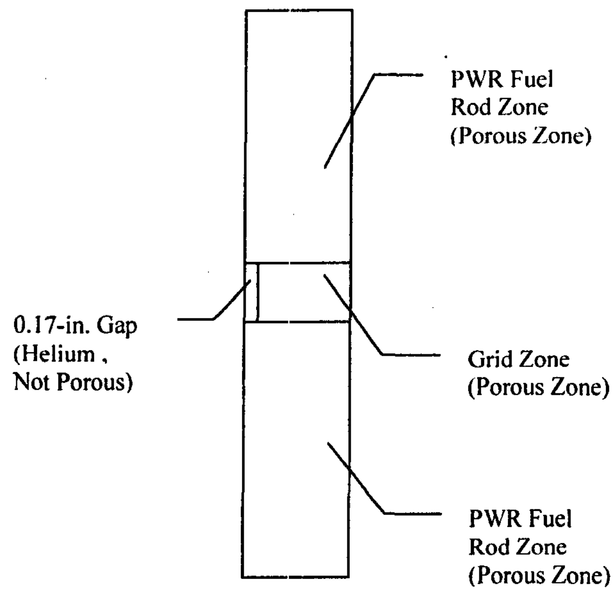


Figure 4.8.2-3 Three-Dimensional Fluent Quarter-Symmetry Model for the Flow Around the Grid



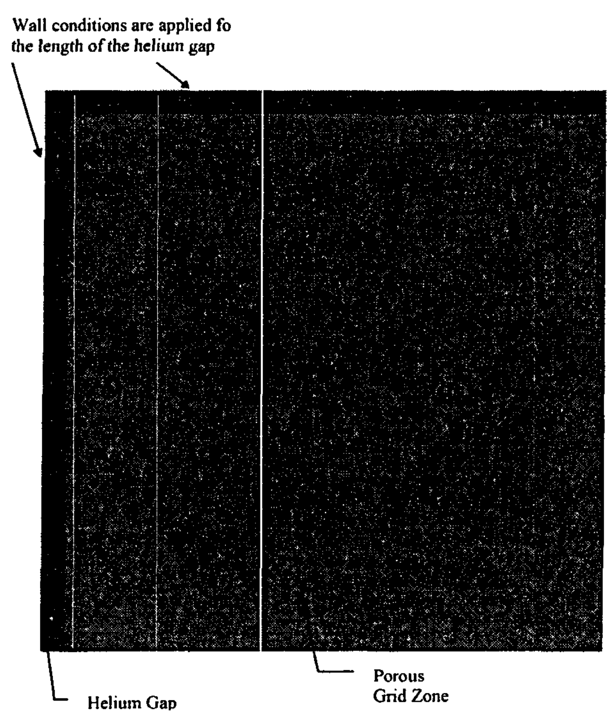
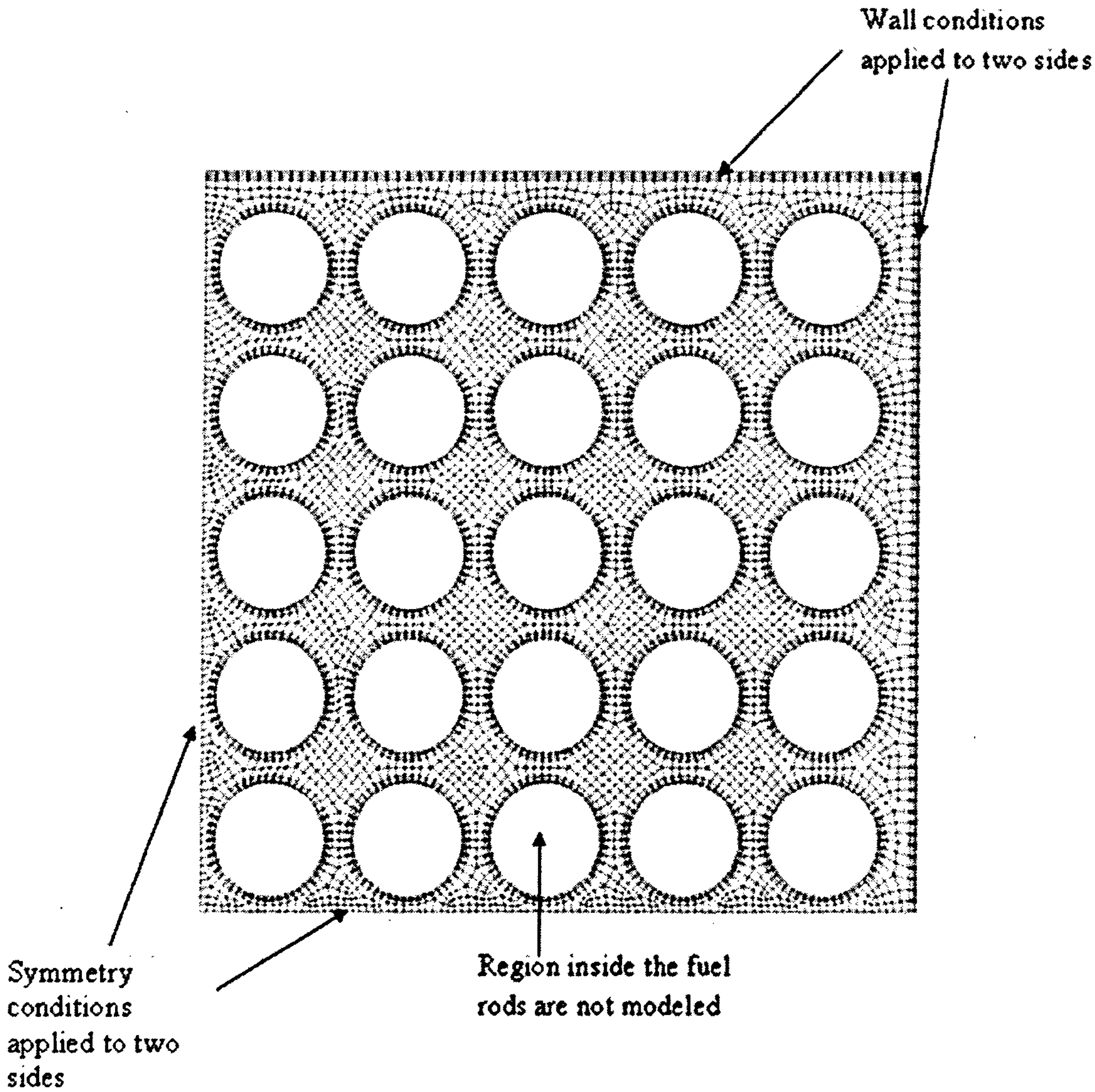


Figure 4.8.2-4 Cross-Sectional View of the Three-Dimensional Fluent Model of a 10×10 BWR Fuel Assembly



4.8.3 Benchmark Evaluation of the Two-Dimensional Axisymmetric Methodology for Annular Cooling in the Concrete Cask for MAGNASTOR

In this section, a benchmark evaluation is performed to evaluate the adequacy of the k-ω and the low Reynold's (low Re) k-ε turbulent flow models that can be used in the evaluation of the flow in the annulus between the canister and the concrete cask. A thermal evaluation using two-dimensional modeling methodology is performed for a system for which a thermal test has been conducted. The thermal test is described in EPRI TR-100305 [21]. The results of the thermal evaluation using the two-dimensional methodology performed in this section show that both turbulent flow models provide conservative temperatures for the canister surface and the concrete cask liner. This thermal benchmark evaluation confirms that the use of the k-ω turbulence model, in conjunction with the two-dimensional methodology, is conservative and, therefore, acceptable for use in the thermal evaluation of MAGNASTOR.

4.8.3.1 Introduction

The thermal design of MAGNASTOR rejects heat from the canister surface to the ambient environment via convection and radiation. Ambient air enters the base of the concrete cask, removes heat via convection from the canister surface, as well as from the surface of the concrete liner, and exits the top of the concrete cask through radial outlets. Radiation of heat from the canister surface to the concrete liner also occurs, which allows the heat to then be convected into the annulus region or conducted through the thickness of the concrete cask. The annulus region is axisymmetric, with the exception of the air inlet and the air outlet, thus lending itself to representation by a two-dimensional axisymmetric model. While the air inlet and air outlet are rectangular in shape, the cross-sectional area of the air inlet and air outlet in an axisymmetric model can vary radially to account for the constant cross-sectional area in the actual test article. A single height for the inlets and outlets can be used, provided the modeled height does not represent more cross-sectional area than the actual inlet and outlet. An important consideration for the analysis of the annulus air flow is the identification of the turbulent flow models. Two models are available: k-ω and low Re k-ε turbulent flow models, which are described in the FLUENT documentation [12]. Selection of the turbulent flow model for MAGNASTOR is based on the thermal test data provided in EPRI TR-100305 [21].

4.8.3.2 Purpose

The purpose of this section is to provide a thermal benchmark, which will demonstrate that the k-ε turbulent flow model used in the MAGNASTOR thermal evaluation is conservative.

4.8.3.3 Description of the Thermal Test

In EPRI TR-100305 [21], thermal testing was performed for a vertical concrete cask loaded with a canister containing 17 PWR fuel assemblies with a total heat load of 14.9 kW. The basket contained in the cask during testing was comprised of 17 square slots in which the basket walls were constructed of carbon steel. A series of thermal tests were performed that corresponded to different canister conditions, as well as different air inlet and air outlet conditions. To minimize the uncertainty introduced by other thermal behavior, either inside the canister or outside the canister, the test using the vacuum condition with fully opened vents was employed. This test was conducted inside a large structure, which removed the uncertainty of solar insolance affecting the surface temperatures. Additionally, the method and location in which the inlet temperatures were measured were also documented. Axial profiles of the temperatures for the canister surface, as well as the concrete liner surface, were provided in the results published for the thermal test. The temperature profile provides the basis for the comparison of the performance of the different turbulent flow models.

4.8.3.4 Fluent Model Description

The FLUENT two-dimensional axisymmetric model of the VSC-17 is comprised of the canister and the concrete cask. The definition of the regions and the cells comprising the model is shown in Figure 4.8.3-1. Since the vacuum condition is being modeled in the canister, the only region to support fluid flow is the air annulus region between the canister and the concrete liner. The edge of the model corresponds to the outer surface of the concrete cask. The model contains the same changes in direction in the air inlet and the air outlet as exist in the concrete cask used in the thermal test. The heights of the air inlet and air outlet for each segment are selected to allow the physical cross-sectional area to bound the area contained in the FLUENT model.

There are two parameters of interest that influence the heat rejection into the annulus region. Since the heat is being radiated from the canister to the inner liner of the concrete cask, the emissivity of the two facing surfaces (the outer surface of the canister and the inner surface of the liner of the concrete cask) can directly influence the heat transfer. In this evaluation, an emissivity value of 0.7 was used for the carbon steel surfaces. More important is the selection of one of the turbulent flow models for the air flow up through the annulus region: a transitional turbulent flow model (k-ω model) or a low Re turbulent flow model (low Re k-ε model). In FLUENT, either turbulent flow model can be selected. Unlike the specification of emissivity as a property of the surface. the use of a particular turbulence model defines certain requirements for the cells adjacent to the wall. The radial size of the cell divisions near the wall is typically compared to a dimensionless quantity defined as y+ [12]. Guidelines contained in Reference 12

recommend using a y+ of near unity for the transitional model (k-ω) and for the low Re k-ε model. This implies that the near wall cell divisions for the models are significantly refined near the wall.

4.8.3.5 Effective Properties for the Basket and Fuel Region

For the regions corresponding to the basket, effective properties are employed in the analysis. The effective thermal properties for the basket region are computed using an ANSYS model shown in Figure 4.8.3-2. In Reference 21, the description of the basket indicates that a cylindrical shell (connected to the outer basket tubes) forms part of the surface facing the inner surface of the canister. Outside of the axial locations that do not have the cylindrical shell, the outer surface of the outer basket slots faces the inner surface of the canister shell directly. The model shown in Figure 4.8.3-2 models the cylindrical shell for the full length of the basket. The cylinder shell, where it does exist in the canister used in the thermal test, provides an additional radiation shield that reduces the effectiveness of the radiation heat transfer from the outer basket tubes to the canister shell. This would result in higher basket temperatures in the analyses. In the FLUENT model in Figure 4.8.3-1, there is a gap between the outer radius of the cylindrical shell and the inner surface of the canister. Between these two surfaces, radiation is simulated using conduction properties that have a cubic temperature dependency.

The basket cross-section model contains the carbon steel basket and the fuel regions, which are modeled with homogeneous orthotropic thermal conductivities. To determine the temperature-dependent effective thermal conductivity of the basket region, a series of temperatures is applied to the boundary of the model (as shown in Figure 4.8.3-2). Solutions for each boundary condition determine the maximum temperature of the basket and the associated change in temperature from the boundary to the maximum temperature location. The effective thermal conductivities are determined using the same expression employed for MAGNASTOR in Section 4.4.1.2.

4.8.3.6 Boundary Conditions

The outer edges of the model correspond to the outer surface of the concrete cask. Two cases are presented in this section to assess the performance of each turbulent flow model. The boundary conditions employed for each model were identical, with the exception of the selection of the turbulent flow model.

Temperature Specification

The edge of the model includes not only the air inlet and the air outlet, but also the remainder of the concrete cask surface. For the air inlets, the average temperature of the test recorded

ambients for the vacuum test for the fully opened inlets (Run No. 6 in [21]) was applied as the temperature for the air inlet in the model. For the remainder of the concrete cask surface, a temperature of 26°C was used for computation of the heat transfer by natural convection from the side and top of the concrete cask. A film coefficient was also specified for the bottom surface of the model to maximize the heat transfer to the base, thereby reducing the heat flux to the canister surface.

Heat Generation

The total heat load applied to the active fuel region of the model was 14.9 kW, and a user specified function reflected the power profile curve for the fuel in EPRI TR-100305 [21]. The power distribution has a peaking factor of 1.2. The heat generation was assumed to be uniformly distributed over the radial direction from the basket centerline to the outer radius of the porous media region.

Buoyancy

Since the annulus gas was specified as an ideal gas, the only condition required to enact buoyancy as a driving force for the air is to set the gravity acceleration as -9.8 m/sec^2.

An additional parameter that must be specified is the "operating" density at the air inlet. Since the annulus gas is being treated as an ideal gas, the "operating" density was specified to be the density of the gas at the inlet temperature for a site elevation of 1,400 m.

4.8.3.7 Analysis Results

The temperature profiles for the two turbulent flow models for the canister surface and for the concrete cask liner surface are shown in Figure 4.8.3-3 and Figure 4.8.3-4, respectively. The results confirm that both turbulent flow models conservatively predict the temperatures on both the canister surface and the concrete liner surface. The temperature profiles for the low Re k-ε model provided a slight improvement over the k-ω turbulent flow model.

4.8.3.8 Application of the Benchmark to the MAGNASTOR Evaluation

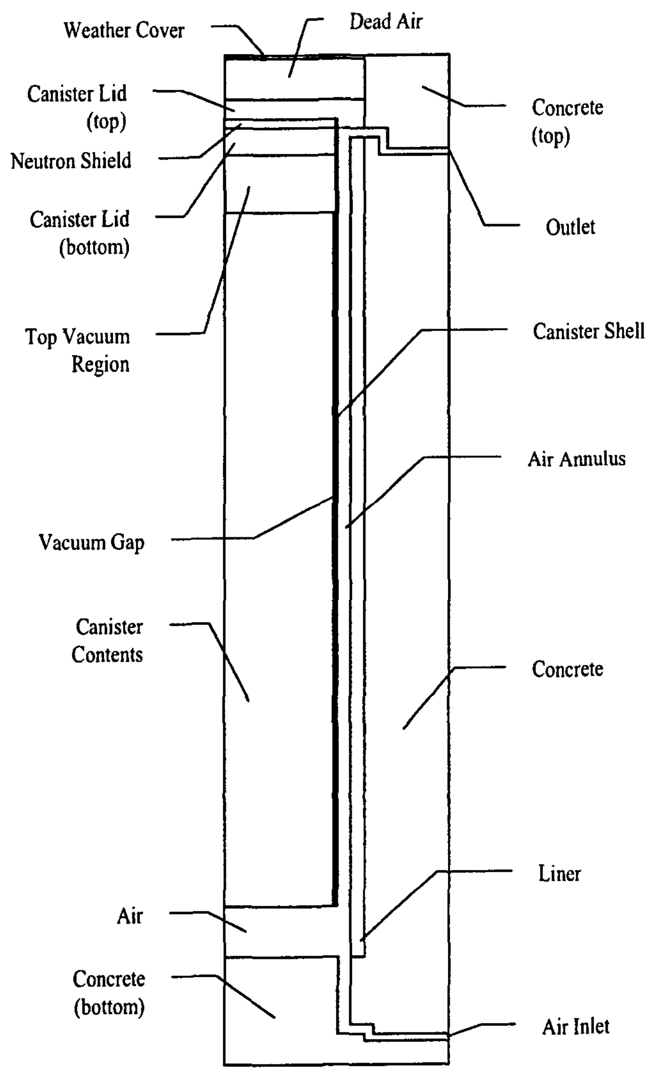
The primary purpose of the preparation of this benchmark is to confirm the selection of the turbulent flow model, and for this reason, the vacuum test in EPRI TR-100305 [21] was selected, which minimized the uncertainties of the thermal behavior internal to the canister. The air flow in the annulus is primarily controlled by the height, the radial thickness of the annulus and the heat load. Since the test in EPRI TR-100305 [21] employed actual fuel assemblies, the height of the annulus in the thermal test and in the MAGNASTOR design are sufficiently similar. The thicknesses of the annulus region for the thermal test and for the MAGNASTOR are 3 inches and

3.75 inches, respectively. A metric for buoyancy-driven flows for vertical parallel surfaces is a modified Rayleigh's number in which the standard Rayleigh number is factored by the ratio (D/L) of the gap thickness (D) and the length (L). Since D/L is actually larger for the MAGNASTOR design, this would indicate that the modified Rayleigh number is larger for MAGNASTOR, resulting in increased convection. Likewise, the design basis heat load for MAGNASTOR is 35.5 kW, as compared to the thermal test using 14.9 kW. Increased heat load would only increase the level of turbulence in the annulus region.

4.8.3.9 Conclusions

In this section, a thermal evaluation has been performed for the thermal test described in EPRI TR-100305 [21]. The analysis results indicate that the two-dimensional axisymmetric modeling methodology using the k-ω turbulent flow model is acceptable to determine a bounding maximum fuel temperature and bounding concrete temperatures. The benchmark also confirms the use of the operating density associated with the ambient temperature for the concrete cask.

Figure 4.8.3-1 Two-Dimensional Axisymmetric Fluent Model of the VSC-17



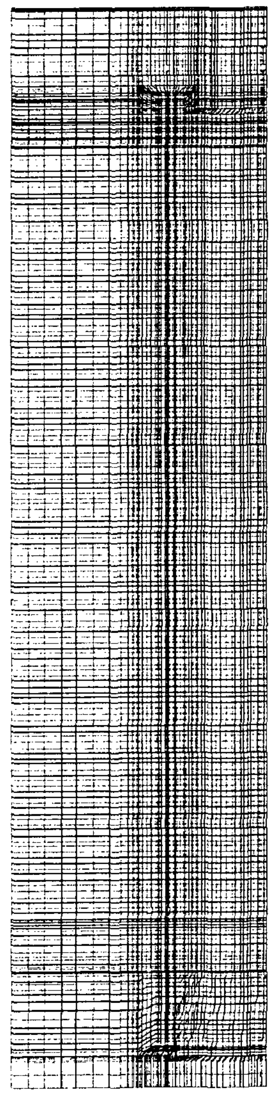


Figure 4.8.3-2 ANSYS Model for Effective Properties Calculation

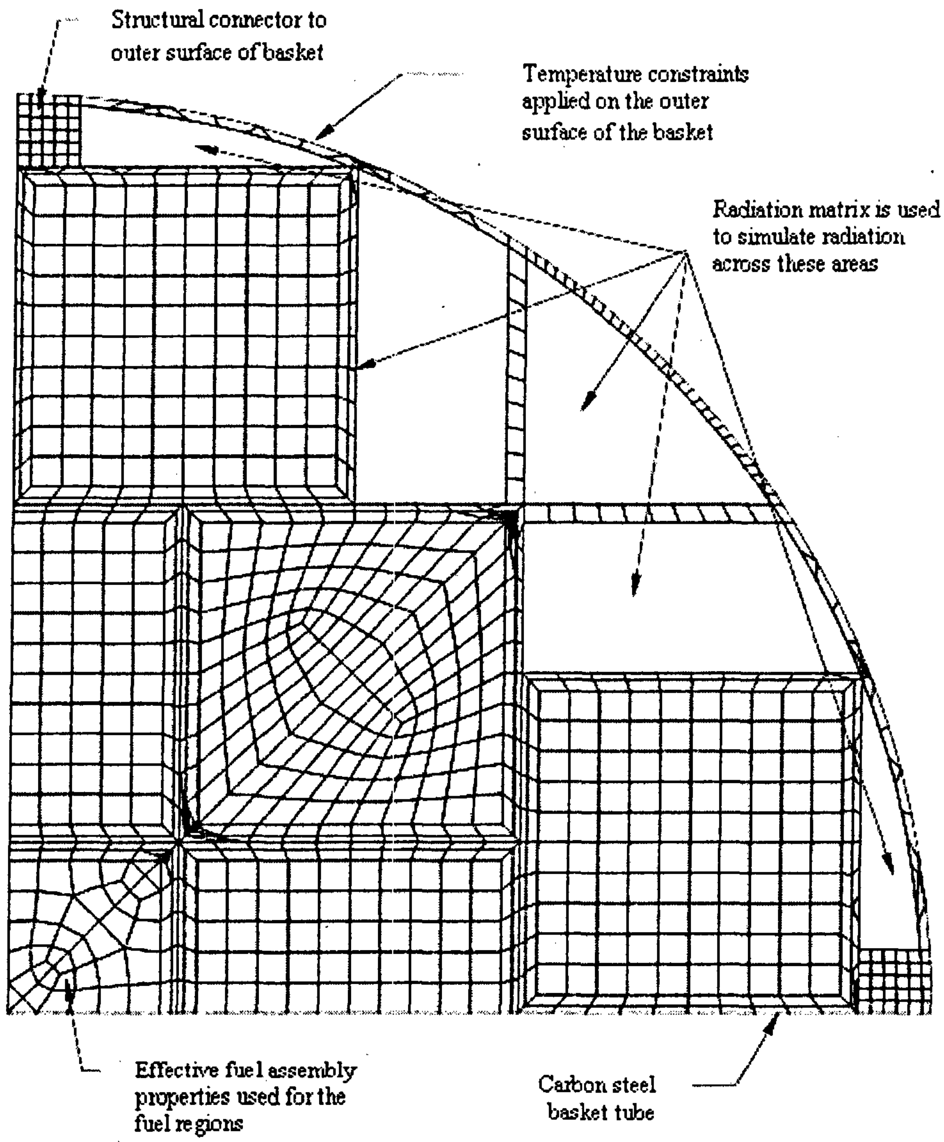


Figure 4.8.3-3 Temperature Profiles for the Canister Surface

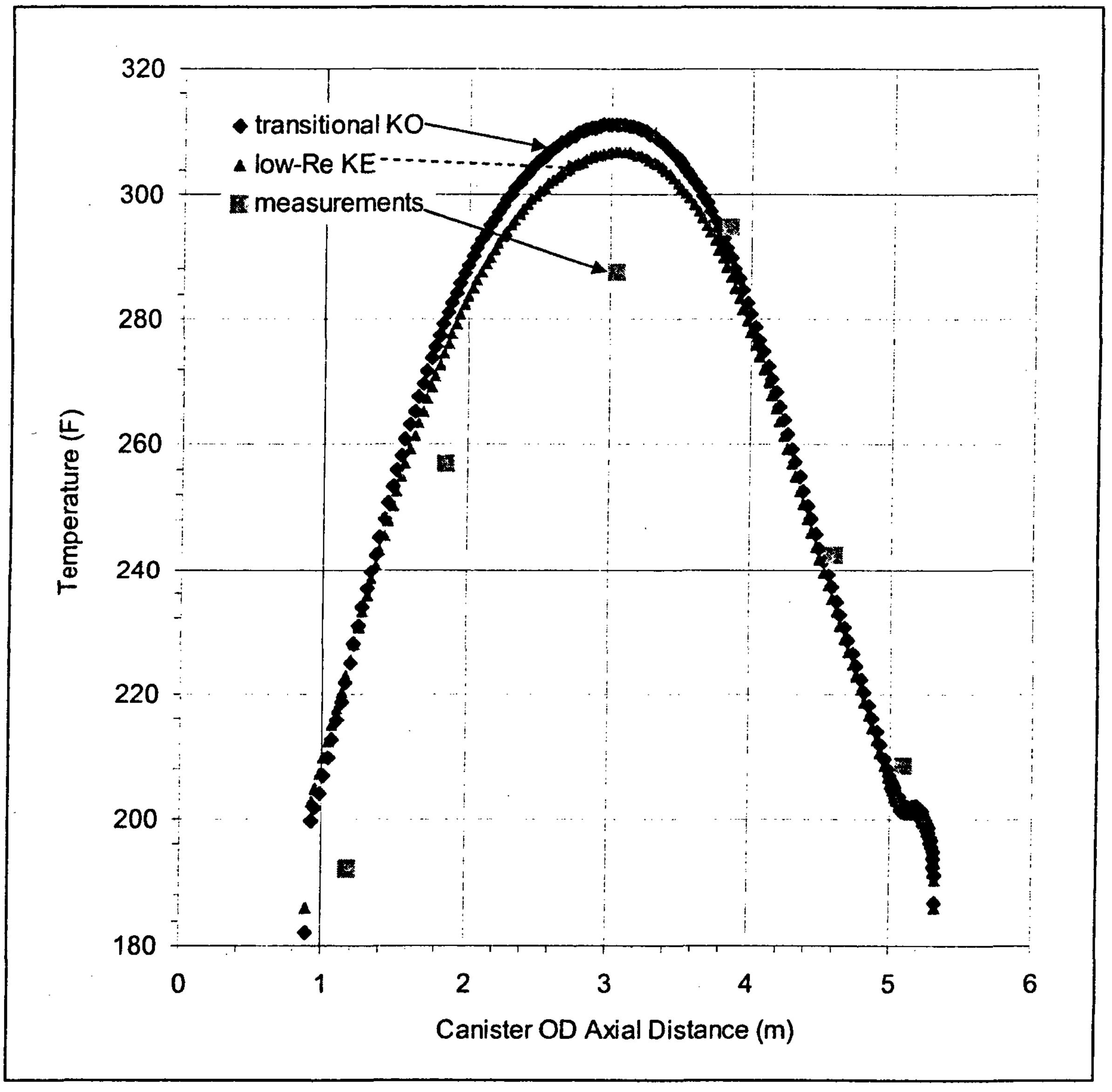
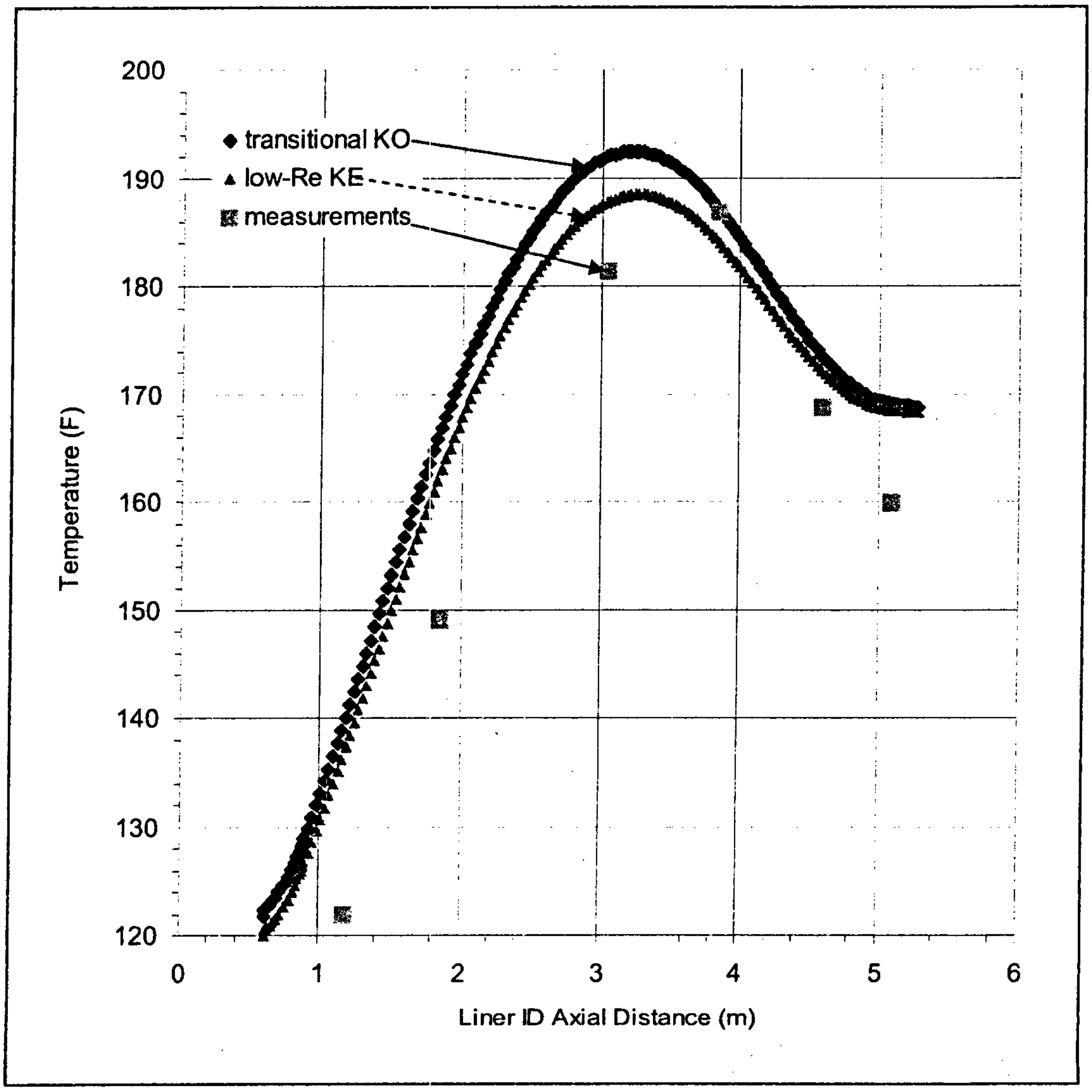


Figure 4.8.3-4 Temperature Profiles for the Concrete Liner Surface



Chapter 5

Chapter 5
Shielding Evaluation

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5.1 Cask Shielding Discussion and Dose Results

The TSC is loaded and sealed inside a transfer cask and then moved into a concrete cask for placement on the ISFSI pad. Dose evaluations are performed for the various TSC contents when the TSC is inside the transfer cask or the concrete cask.

With the exception of the offsite dose discussion, the dose results are presented based on bounding heat loads and corresponding source terms based on a 37 kW PWR cask heat load and a 35 kW BWR cask heat load. Offsite dose results are produced by similar bounding values of a 40 kW PWR cask heat load and a 38 kW BWR cask heat load. Thermal evaluations restrict PWR payloads to 35.5 kW and BWR payloads to 33 kW. Cool time tables for the thermally restricting payloads are listed in Section 5.8.9. All dose rates calculated at higher cask heat loads are bounding for the reduced heat load produced by the Section 5.8.9 cool time tables. For any fuel type, burnup, initial enrichment, and cool time combination allowed, additional cool time and, therefore, reduced sources are associated with the lower cask heat load. This conclusion applies also to the PWR preferential loading pattern where outer and intermediate zone heat loads and, therefore, sources were decreased with the inner zone remaining constant at 800 watts.

5.1.1 Transfer Cask Shielding Discussion and Dose Results

The transfer cask radial shield is comprised of steel inner and outer shells connected by solid steel top and bottom forgings. The shell encloses a lead gamma shield and a solid borated polymer (NS-4-FR) neutron shield. The TSC shell and the basket internal structure provide additional radial shielding. The transfer operation bottom shielding is provided by the TSC bottom plate and solid steel transfer cask doors. The TSC closure lid provides radiation shielding at the top of the TSC.

The three-dimensional transfer cask shielding analysis provides a complete, nonhomogenized representation of the transfer cask and TSC structure. The model assumes the following TSC/transfer cask configuration for all dose rate evaluations.

- Dry canister cavity
  The majority of the TSC operations, in particular closure lid welding, are performed with the TSC cavity filled with water. Evaluating a dry canister cavity is conservative. Note that the water filling the TSC/transfer cask annulus between the inflatable seals is modeled.

- 6-in auxiliary weld shield
  Closure lid weld operations are typically performed with an automated weld system that is mounted on a weld platform. The presence of this platform provides significant auxiliary shielding during the TSC closure operation.
- Homogenization of the fuel assembly into five source regions
  While TSC and concrete cask features are discretely modeled, the fuel assembly is homogenized into upper and lower end-fitting (nozzle) regions, upper and lower plenum regions (lower plenum regions are modeled only for B&W fuel assemblies), and an active fuel region. For shielded applications, such as in the heavily shielded spent fuel transfer and concrete casks, homogenizing the fuel region does not introduce a significant bias in the dose results presented.

The transfer cask maximum calculated dose rates are shown in Table 5.1.3-1. Payload types producing maximum surface dose rates are listed in Table 5.1.3-3. TSC surface contamination release dose rates are shown in Section 5.6.5. Dose rates are based on a three-dimensional Monte Carlo analysis using surface detectors. Uncertainty in Monte Carlo results is indicated in parentheses. Further detail on the detector geometry is included in Section 5.5. There is no design basis off-normal or accident event that will affect the shielding performance of the transfer cask.

Maximum transfer cask top-, side-, and bottom-surface average dose rates are 250 (2%) mrem/hr, 895 (<1%) mrem/hr, and 3,158 (<1%) mrem/hr, respectively. Access to the bottom of the cask is limited to pool-to-workstation transfer operations and the workstation-to-vertical concrete cask transfer operations. Site ALARA plans should specify limited access to areas below and around the loaded transfer cask during lifting and transfer operations.

5.1.2 Concrete Cask Shielding Discussion and Dose Results

The concrete cask is composed of body and lid components. The body contains the air inlets, air outlets. and the cavity for TSC placement. The lid provides environmental closure for the TSC. The radial shield design is comprised of a carbon steel inner liner surrounded by concrete. The concrete contains radial and axial rebar for structural support. As in the transfer cask, the TSC shell provides additional radial shielding. The concrete cask top shielding design is comprised of the TSC lid and concrete cask lid. The concrete cask lid incorporates both concrete and steel plate to provide additional gamma shielding. The bottom shielding is comprised of the stainless steel TSC bottom plate, the pedestal/air inlet structure, and a carbon steel base plate. Radiation streaming paths consist of air inlets located at the bottom and air outlets located above the top of

the TSC, and above the annulus between the concrete cask body and the TSC. Air inlets and outlets are radial openings to the concrete cask. The inlets and outlets are axially offset from the source regions to minimize dose and meet ALARA principles.

No auxiliary shielding is considered in the concrete cask shielding evaluation. All components relevant to safety performance are explicitly included in the concrete cask model. Homogenization of materials used in the models is limited to the fuel assembly as described in Section 5.1.1.

Refer to Table 5.1.3-2 for a summary of the concrete cask normal condition and accident event maximum calculated dose rates. Listed maximum dose rates include fuel and nonfuel hardware contributions. Payload types producing maximum surface dose rates are listed in Table 5.1.3-3. Refer to Section 5.6.5 for TSC surface contamination release dose rates. Dose rates are based on three-dimensional Monte Carlo analysis using surface detectors. Further detail on the detector geometry is included in Section 5.5.

The maximum concrete cask side (cylindrical) average surface dose rate is 60 (<1%) mrem/hour. On the concrete cask top (disk), the average surface dose rate is 104 (2%) mrem/hour. The maximum inlet and outlet dose rates are 448 and 59 mrem/hr, respectively. No design basis normal condition or accident event exposes the bottom of the concrete cask.

5.1.3 Offsite Dose Discussion and Results

Contributions from concrete casks to site radiation dose exposure are limited to either radiation emitted from the concrete cask surface or a hypothetical release of surface contamination from the TSC. As documented in Section 5.6.5, there is no significant site dose effect from the expected surface contamination of the system. The TSCs are welded and tested to meet leaktight criteria. Therefore, there is no significant effluent source from the TSC contents.

Controlled area boundary exposure from the concrete cask surface radiation is evaluated using the NAC-CASC code. (As previously stated, NAC-CASC is a modified version of SKYSHINE-III.) NAC-CASC primary enhancements to SKYSHINE-III allow the input of an angular surface current and the accounting of concrete cask self-shielding in the array. Both a single cask and a 2×10 array of casks are evaluated. Each cask in the array is assigned the maximum dose (surface current) source allowed by the cask loading tables. A combination of the maximum cask side and top dose cases provides for a conservative estimate on the controlled area boundary exposure, since the different fuel types produce the highest cask surface dose components.

The full year exposure is based on 8,760 hours.

Table 5.1.3-1 Summary of Transfer Cask Maximum Dose Rates

	Transfer Cask Surface (mrem/hr with relative uncertainty)			1 Meter from Surface (mrem/hr with relative uncertainty)		
Source	Side	Top	Bottom[a]	Side	Top	Bottom
Neutron	1,266 (2.0%)	13 (3.3%)	1,234 (4.3%)	396 (1.6%)	4 (3.7%)	295 (6.1%)
Gamma	238 (1.4%)	663 (1.5%)	5,051 (3.6%)	105 (0.8%)	172 (2.7%)	2,518 (2.3%)
Total	1,504 (1.7%)	676 (1.5%)	6,285 (2.9%)	501 (1.3%)	176 (2.7%)	2,813 (2.1%)

Table 5.1.3-2 Summary of Concrete Cask Maximum Dose Rates

		Cask Surface (mrem/hr with relative uncertainty)		1 Meter from Surface (mrem/hr with relative uncertainty)	
Condition	Source	Side[b]	Top	Side[b]	Top
Normal	Neutron	1 (8.2%)	5 (11.6%)	1 (5.4%)	1 (8.8%)
	Gamma	81 (1.8%)	425 (3.2%)	42 (1.3%)	109 (3.3%)
	Total	82 (1.6%)	430 (3.1%)	43 (1.1%)	110 (3.3%)
Design Basis Accident [d]	Neutron	9 (2.5%)	N/A[c]	4 (2.1%)	N/A[c]
	Gamma	546 (6.7%)	N/A[c]	282 (5.1%)	N/A[c]
	Total	555 (6.5%)	N/A[c]	286 (5.0%)	N/A[c]

[a] Includes fuel, thimble plug, and BPRA contribution. A full loading of 9 CEAs will increase bottom dose by 3,150 mrem/hr on contact.
[b] Not including air inlet and outlet streaming paths. Maximum air inlet and outlet dose rates including fuel, BPRA, and thimble plug contributions are 448 (1.3%) and 59 (1.2%) mrem/hr, respectively. At a distance of 1 m from the cask surface the air inlet and outlet maximum dose rates are 75 (2.6%) and 6.3 (2.4%) mrem/hr, respectively. CEAs may add an additional 32.3 mrem/hr to the inlet dose. There is no CEA contribution to the outlet dose.
[c] Dose effect is enveloped by the concrete cask side dose. Conservatively calculated for a 40 kW PWR and 38 kW BWR payload.
[d] At the missile impact area.

5.8.3 37-Assembly PWR System

This section presents the detailed evaluations of the concrete and transfer casks loaded with PWR fuel assemblies.

5.8.3.1 PWR Fuel and Basket Models

The three-dimensional shielding evaluation includes a homogenized fuel assembly model and a detailed three-dimensional basket model.

5.8.3.1.1 Fuel Assembly Model

Based on the fuel assembly physical parameters provided in Table 5.8.1-1 and the hardware masses in Table 5.8.1-2, homogenized treatments of fuel assembly source regions are developed. The homogenized fuel assembly is represented in the model as a stack of boxes with width equal to the fuel assembly width. The height of each box corresponds to the modeled height of the corresponding assembly region.

Sample fuel and nonfuel hardware homogenizations for the source regions for the 17a assembly are shown in Table 5.8.3-1 and Table 5.8.3-2. Similar composition sets are generated for the remaining fuel assembly hybrids.

5.8.3.1.2 Basket Model

The basket is composed of coated carbon steel tubes, pinned together at the corners, and held together by side and corner weldments. Twenty-one fuel tubes, in combination with the weldments, form 37 fuel openings. The corner weldments provide structural support, but do not serve as a physical restraint to the fuel assemblies. Pin spacers maintain the tube axial spacing within the TSC cavity. Each fuel tube nominally contains four metallic composite neutron absorber sheets. In dry storage and transfer, the presence of the neutron absorber sheets provides minimal shielding and could, therefore, be removed without a significant increase in exposure. Key basket characteristics are shown in Table 5.8.3-3. Radial and axial sketches of the basket within the TSC are shown in Figure 5.8.3-1 and Figure 5.8.3-2, respectively.

5.8.3.2 Minimum Cool-time Specification

SAS2H generates heat loads for all PWR fuel types listed in Section 5.8.1.1. Based on a 37 kW per cask (1 kW per assembly) heat load, minimum allowed cool times for each fuel type are calculated. Calculated heat loads account for fuel material (actinide and fission product) and hardware (light element) generated sources. Minimum cool times are conservatively rounded up to the nearest one-tenth of a year. A sample minimum cool time calculation for the 17a assembly is shown in Table 5.8.3-4. The resulting minimum cool times are listed in assembly specific loading tables (see Table 5.8.3-5). Note that cool times for maximum assembly average burnups less than or equal to 25,000 MWd/MTU are not tabulated since they are equal to four years for all seven PWR fuel types. However, the following minimum enrichments for these assembly average burnups must be invoked.

Max. Assembly Avg. Burnup (MWd/MTU)	Min. Assembly Avg. Initial Enrichment (wt% ^{235}U)
10,000	1.3
15,000	1.5
20,000	1.7
25,000	1.9

The loading table removes combinations of high assembly average burnup and low enrichment (e.g., 60 GWd/MTU and 1.9 wt% ^{235}U) from the contents definition. Source term data covering these combinations produces unrealistic source terms due to the complete consumption of fissile uranium early in the burnup cycle and the SAS2H input of a fixed power density. To maintain power density, ORIGEN-S (SAS2H) will substantially increase flux levels, which would not occur during core operation of the assembly, to produce fissile material and to produce power by nonthermal fission. The increased flux level "breeds" higher actinides, which in turn increase source significantly. Since a high burnup and low enrichment combination would require repeated reinsertion of a burned assembly, the combination is excluded.

Minimum cool time tables for the thermal analysis limited heat load are included in Section 5.8.9.

5.8.4 87-Assembly BWR System

This section presents the detailed evaluation of the concrete and transfer casks loaded with BWR fuel assemblies.

5.8.4.1 BWR Fuel and Basket Models

The three-dimensional shielding evaluation includes a homogenized fuel assembly model and a detailed three-dimensional basket model.

5.8.4.1.1 Fuel Assembly Model

Based on the fuel assembly physical parameters provided in Table 5.8.1-4 and the hardware masses in Table 5.8.1-5, homogenized treatments of fuel assembly source regions are developed. The homogenized fuel assembly is represented in the model as a stack of boxes with width equal to the fuel assembly width. The height of each box corresponds to the modeled height of the corresponding assembly region.

Sample fuel and nonfuel hardware homogenizations for the source regions for the 08b assembly are shown in Table 5.8.4-1 and Table 5.8.4-2, respectively. The resulting fuel compositions on an atom/barn-cm basis are shown in Table 5.8.4-3. Similar compositions sets are generated for the remaining fuel assembly hybrids. Note that the Zirc-2 fuel assembly channel is not included in the model.

5.8.4.1.2 Basket Model

The basket is composed of coated carbon steel tubes, pinned together at the corners, and held together by side and corner weldments. Forty-five fuel tubes, in combination with the weldments, form 89 fuel openings. Two openings are located below the vent port covers. To minimize exposure and meet ALARA constraints, basket capacity is reduced to 87 assemblies. Pin spacers maintain the tube axial spacing within the TSC cavity. Each tube contains four metallic composite neutron absorber sheets. In dry storage and transfer, the presence of the neutron absorber sheets provides minimal shielding and could, therefore, be removed without a significant increase in exposure. Key basket characteristics are shown in Table 5.8.4-4. Radial and axial sketches of basket within the TSC are shown in Figure 5.8.4-1 and Figure 5.8.4-2.

5.8.4.2 Minimum Cool-time Specification

SAS2H generates heat loads for all BWR fuel types listed in Section 5.8.1.2. Based on a 35 kW per cask (0.402 kW per assembly) heat load, minimum allowed cool times for each fuel type are calculated. Calculated heat loads account for fuel material (actinide and fission product) and hardware (light element) generated sources. Minimum cool times are conservatively rounded up to the nearest one-tenth of a year. A sample minimum cool time calculation for the 09b hybrid BWR assembly is shown in Table 5.8.4-5. The resulting minimum cool times are listed in an assembly specific loading table (see Table 5.8.4-6). Note that cool times for maximum assembly average burnups less than or equal to 30,000 MWd/MTU are not tabulated since they are equal to four years for all seven BWR fuel types. However, the following minimum enrichments for these assembly average burnups must be invoked.

Max. Assembly Avg. Burnup (MWd/MTU)	Min. Assembly Avg. Initial Enrichment (wt % ^{235}U)
10,000	1.3
15,000	1.5
20,000	1.7
25,000	1.9
30,000	2.1

Note that the loading table removes combinations of high burnup and low enrichment (e.g., 60 GWd/MTU and 1.9 wt% ^{235}U) from the payload definition. Source term data covering these combinations is generated, but produces unrealistic source terms due to the complete consumption of fissile uranium early in the burnup cycle and the SAS2H input of a fixed power density. To maintain power density, ORIGEN-S (SAS2H) will substantially increase flux levels, which would not occur during core operation of the assembly, to produce fissile material and to produce power by nonthermal fission. The increased flux level "breeds" higher actinides, which in turn increase source significantly. Since a high burnup and low enrichment combination would require repeated reinsertion of a burned assembly, the combination is excluded.

Minimum cool time tables for the thermal analysis limited heat load are included in Section 5.8.9.

5.8.4.3 Transfer Cask Dose Rates

Using the dose response method, cask dose rates are tabulated for all allowed cool time, assembly average burnup, and initial enrichment combinations for each of the assembly types. Maximum dose rates as a function of distance from the cask surface are shown in Figure 5.8.4-3

for the cask radial surface, Figure 5.8.4-5 for the cask top, and Figure 5.8.4-7 for the cask bottom. Breakdowns of the cask surface radial and top dose rates into the source components are shown in Figure 5.8.4-4 and Figure 5.8.4-6. Refer to Table 5.8.4-7 for the maximum transfer cask radial, top, and bottom surface rates, and the contents that develop those dose rates.

5.8.4.4 Concrete Cask Dose Rates

Using the dose response method, concrete cask dose rates are tabulated for all allowed cool time, assembly average burnup, and initial enrichment combinations for each of the assembly types. Maximum dose rates as a function of distance from the concrete cask surface are shown in Figure 5.8.4-8 for the cask radial surface, Figure 5.8.4-10 for the cask top, and Figure 5.8.4-12 and Figure 5.8.4-13 for the cask air outlet and inlets, respectively. Breakdowns of the cask surface radial and top dose rates into the source components are shown in Figure 5.8.4-9 and Figure 5.8.4-11. Refer to Table 5.8.4-8 for the maximum concrete dose surface rates and the contents that develop those dose rates.

5.8.4.5 NAC-CASC / Site Boundary Evaluation

Detailed direct and skyshine dose rates as a function of distance are calculated for a single concrete cask and a 2×10 array of concrete casks based on the model description and method outlined in Section 5.5.3. All allowable payload combinations (i.e., fuel type, initial enrichment, assembly average burnup, and cool time) that meet per assembly heat load limits were reviewed to determine the payloads producing maximum top (axial) and side (radial) dose rates. These payload cases were then run through MCNP using a "direct" solution approach (full source spectrum), rather than the response function method, to generate cask top and side surface radiation currents. The surfaces were treated independently to generate a conservative hybrid source model for a design basis analysis cask.

The maximum TSC heat load applied in the site boundary evaluation is 38 kW versus the 35 kW applied in the cask surface dose evaluations. The site boundary results obtained from the 38 kW pattern conservatively bound those of the maximum 35 kW pattern.

Table 5.8.4-9 lists the surface current description of the bounding BWR source for the cask radial and axial surfaces. The resulting boundary required to meet a 25 mrem/yr limit for an 8,760-hr exposure is listed in Table 5.8.4-10. Figure 5.8.4-16 contains a contour plot of the 25 mrem/yr boundary. Yearly exposure as a function of distance is plotted in Figure 5.8.4-14 for a single cask and in Figure 5.8.4-15 for the cask array. A breakdown of the neutron, gamma, and

neutron induced gamma radiation components as a function of distance is provided below each plot.

A sample BWR NAC-CASC input file is provided in Section 5.8.8. The detector location grid is truncated in the listed input file.

5.8.7 Preferential Loading of PWR Fuel

In order to envelop fuel assemblies with heat loads higher than 1 kW, a three-zone preferential loading pattern is proposed as follows.

Zone Description	Designator	Heat Load [W/assy]	# Assemblies
Inner Ring	A	960	9
Middle Ring	B	1,300	12
Outer Ring	C	800	16

Preferential and uniform loading patterns limit total cask heat load to 37 kW. As will be seen in the results section, the maximum dose rate for the preferential loading pattern is less than that calculated for a uniform pattern.

A sketch of the PWR basket and loading pattern is shown in Figure 5.8.7-1.

Minimum cool time tables for the thermal analysis limited preferential heat load pattern are included in Section 5.8.9.

5.8.7.1 Input File Setup

Based on a three-zone pattern, the source and tally descriptions are modified in the MCNP models to consider the sources in the appropriate basket locations with the proper scaling on the tally cards. For each cask/detector combination, three sets of runs (A, B and C) are needed to characterize the dose rate response.

5.8.7.2 Results

Maximum and average surface dose rates for the preferential pattern are shown in Table 5.8.7-1, with the corresponding limiting results for the uniform pattern. The maximum dose rate for the analyzed preferential loading pattern is less than that calculated for a uniform pattern at each detector surface for both casks.

The concrete cask radial and top axial average dose rates are less in the preferential pattern, indicating the conservatism inherent in using the uniform pattern to characterize the restricted area and controlled area boundaries. Although the transfer cask average dose rates are slightly higher for the preferential pattern, the maximum dose rates on the top of the cask, which are higher for the uniform pattern, are the dominant contributor to occupational exposures. As such, the occupational exposure evaluations for TSC transfer are also conservative.

5.8.7.3 Cool-time Tables

Cool times for the three preferential loading pattern heat loads are shown in Table 5.8.7-2 through Table 5.8.7-4. Results are not shown if all cool times for a given assembly average burnup are 4.0 years. The minimum enrichments (as a function of burnup) from Section 5.8.3.2 must be invoked.

5.8.9 Thermal Analysis Limited Cool-Time Tables

5.8.9.1 PWR

Fuel assembly loading tables are generated for a cask heat load of 35.5 kW with preferential (1.2 kW max) and uniform (959 W/assy) heat load patterns. Minimum cool times are summarized for the uniform and preferential heat load patterns.

The three-zone preferential loading pattern for the 35.5 kW PWR cask is proposed as follows.

Zone Description	Designator	Heat Load [W/assy]	# Assemblies
Inner Ring	A	922	9
Middle Ring	B	1,200	12
Outer Ring	C	800	16

The sketch of the PWR basket and preferential loading pattern is shown in Figure 5.8.7-1.

Allowed low burnup (up to 30,000 MWd/MTU) fuel loadings are shown in Table 5.8.9-1. Note that the listed minimum cool times at each burnup step are bounding for all fuel types and initial enrichments above the minimum enrichment specified. Collapsing the fuel type and initial enrichment-dependent minimum cool time matrix to a single value may result in a minimum cool time longer than individual values presented for higher burnups in the detailed tables that follow.

Table 5.8.9-2 contains the minimum cool times for a uniform heat load of 959 W/assy for a total cask heat load of 35.5 kW. Tables 5.8.9-1 through 5.8.9-5 contain the minimum cool times for the preferential loading of a 35.5 kW cask.

Decay heat associated with loading nonfuel components requires an increase in the minimum fuel assembly cool time. Reductions in cask heat load did not change the incremental cool time increase documented in Section 5.8.3.

Table 5.8.9-1 Low Burnup PWR Fuel Loading Table

Max. Assembly Avg. Burnup (MWd/MTU)	Min. Assembly Avg. Initial Enrichment (wt% ^{235}U)	Minimum Cool Time (yrs)			
Heat Load per Assy	--	959 W	800 W	922 W	1,200 W
10,000	1.3	4.0	4.0	4.0	4.0
15,000	1.5	4.0	4.0	4.0	4.0
20,000	1.7	4.0	4.0	4.0	4.0
25,000	1.9	4.0	4.3	4.0	4.0
30,000	2.1	4.4	5.2	4.5	4.0

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.1	4.1	4.6	4.7	4.4	4.7	4.7
2.3 ≤ E < 2.5	4.0	4.1	4.5	4.7	4.4	4.6	4.6
2.5 ≤ E < 2.7	4.0	4.0	4.5	4.6	4.3	4.6	4.6
2.7 ≤ E < 2.9	4.0	4.0	4.5	4.5	4.3	4.5	4.5
2.9 ≤ E < 3.1	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.1 ≤ E < 3.3	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.3 ≤ E < 3.5	4.0	4.0	4.3	4.4	4.2	4.4	4.4
3.5 ≤ E < 3.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
3.7 ≤ E < 3.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
3.9 ≤ E < 4.1	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.1 ≤ E < 4.3	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.3 ≤ E < 4.5	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.5 ≤ E < 4.7	4.0	4.0	4.1	4.2	4.0	4.2	4.2
4.7 ≤ E < 4.9	4.0	4.0	4.1	4.2	4.0	4.2	4.2
E ≥ 4.9	4.0	4.0	4.1	4.2	4.0	4.2	4.2
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.3	4.4	5.0	5.1	4.7	5.0	5.0
2.5 ≤ E < 2.7	4.3	4.4	4.9	5.0	4.7	5.0	5.0
2.7 ≤ E < 2.9	4.2	4.3	4.8	5.0	4.6	4.9	4.9
2.9 ≤ E < 3.1	4.2	4.3	4.8	4.9	4.6	4.9	4.9
3.1 ≤ E < 3.3	4.1	4.2	4.7	4.9	4.5	4.8	4.8
3.3 ≤ E < 3.5	4.1	4.2	4.7	4.8	4.5	4.8	4.8
3.5 ≤ E < 3.7	4.1	4.1	4.6	4.8	4.4	4.7	4.7
3.7 ≤ E < 3.9	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.9 ≤ E < 4.1	4.0	4.1	4.6	4.7	4.4	4.7	4.7
4.1 ≤ E < 4.3	4.0	4.0	4.5	4.7	4.3	4.6	4.6
4.3 ≤ E < 4.5	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.5 ≤ E < 4.7	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.7 ≤ E < 4.9	4.0	4.0	4.4	4.6	4.3	4.5	4.5
E ≥ 4.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.7	4.8	5.5	5.7	5.2	5.6	5.6
2.5 ≤ E < 2.7	4.6	4.7	5.4	5.6	5.1	5.5	5.5
2.7 ≤ E < 2.9	4.6	4.7	5.3	5.5	5.0	5.4	5.4
2.9 ≤ E < 3.1	4.5	4.6	5.3	5.4	5.0	5.4	5.4
3.1 ≤ E < 3.3	4.5	4.5	5.2	5.4	4.9	5.3	5.3
3.3 ≤ E < 3.5	4.4	4.5	5.1	5.3	4.9	5.2	5.2
3.5 ≤ E < 3.7	4.4	4.5	5.0	5.2	4.8	5.2	5.2
3.7 ≤ E < 3.9	4.3	4.4	5.0	5.2	4.8	5.1	5.1
3.9 ≤ E < 4.1	4.3	4.4	5.0	5.1	4.7	5.1	5.1
4.1 ≤ E < 4.3	4.3	4.4	4.9	5.1	4.7	5.0	5.0
4.3 ≤ E < 4.5	4.2	4.3	4.9	5.0	4.7	5.0	5.0
4.5 ≤ E < 4.7	4.2	4.3	4.9	5.0	4.6	5.0	5.0
4.7 ≤ E < 4.9	4.2	4.3	4.8	5.0	4.6	4.9	4.9
E ≥ 4.9	4.1	4.2	4.8	4.9	4.5	4.9	4.9
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.0	5.2	5.9	6.1	5.6	6.0	6.0
2.7 ≤ E < 2.9	5.0	5.1	5.9	6.0	5.5	5.9	5.9
2.9 ≤ E < 3.1	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.1 ≤ E < 3.3	4.9	4.9	5.7	5.9	5.4	5.8	5.8
3.3 ≤ E < 3.5	4.8	4.9	5.7	5.8	5.3	5.7	5.7
3.5 ≤ E < 3.7	4.7	4.8	5.6	5.8	5.2	5.7	5.7
3.7 ≤ E < 3.9	4.7	4.8	5.5	5.7	5.2	5.6	5.6
3.9 ≤ E < 4.1	4.6	4.8	5.5	5.7	5.1	5.6	5.6
4.1 ≤ E < 4.3	4.6	4.7	5.4	5.6	5.1	5.5	5.5
4.3 ≤ E < 4.5	4.5	4.7	5.4	5.6	5.0	5.5	5.5
4.5 ≤ E < 4.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
4.7 ≤ E < 4.9	4.5	4.6	5.3	5.5	5.0	5.4	5.4
E ≥ 4.9	4.5	4.5	5.2	5.4	4.9	5.4	5.4

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.3	5.4	6.2	6.4	5.8	6.3	6.3
2.7 ≤ E < 2.9	5.2	5.3	6.1	6.3	5.7	6.2	6.2
2.9 ≤ E < 3.1	5.1	5.2	6.0	6.2	5.7	6.1	6.1
3.1 ≤ E < 3.3	5.0	5.1	5.9	6.1	5.6	6.0	6.0
3.3 ≤ E < 3.5	4.9	5.1	5.9	6.0	5.5	5.9	5.9
3.5 ≤ E < 3.7	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.7 ≤ E < 3.9	4.8	4.9	5.7	5.9	5.4	5.8	5.8
3.9 ≤ E < 4.1	4.8	4.9	5.7	5.9	5.3	5.8	5.8
4.1 ≤ E < 4.3	4.7	4.9	5.6	5.8	5.3	5.7	5.7
4.3 ≤ E < 4.5	4.7	4.8	5.6	5.8	5.2	5.7	5.7
4.5 ≤ E < 4.7	4.7	4.8	5.5	5.7	5.2	5.6	5.6
4.7 ≤ E < 4.9	4.6	4.7	5.5	5.7	5.1	5.6	5.6
E ≥ 4.9	4.6	4.7	5.5	5.6	5.1	5.6	5.6
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.5	5.6	6.5	6.7	6.0	6.6	6.6
2.7 ≤ E < 2.9	5.4	5.5	6.4	6.6	5.9	6.5	6.5
2.9 ≤ E < 3.1	5.3	5.4	6.3	6.5	5.9	6.4	6.4
3.1 ≤ E < 3.3	5.2	5.3	6.2	6.4	5.8	6.3	6.3
3.3 ≤ E < 3.5	5.1	5.3	6.1	6.3	5.7	6.2	6.2
3.5 ≤ E < 3.7	5.0	5.2	6.0	6.2	5.7	6.1	6.1
3.7 ≤ E < 3.9	5.0	5.1	5.9	6.2	5.6	6.0	6.0
3.9 ≤ E < 4.1	4.9	5.1	5.9	6.1	5.5	6.0	6.0
4.1 ≤ E < 4.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
4.3 ≤ E < 4.5	4.9	5.0	5.8	6.0	5.4	5.9	5.9
4.5 ≤ E < 4.7	4.8	4.9	5.7	5.9	5.4	5.8	5.8
4.7 ≤ E < 4.9	4.8	4.9	5.7	5.9	5.3	5.8	5.8
E ≥ 4.9	4.7	4.9	5.7	5.9	5.3	5.8	5.8

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.7	5.8	6.8	7.0	6.3	6.9	6.9
2.7 ≤ E < 2.9	5.6	5.7	6.7	6.9	6.2	6.8	6.8
2.9 ≤ E < 3.1	5.5	5.6	6.6	6.8	6.0	6.7	6.7
3.1 ≤ E < 3.3	5.4	5.6	6.5	6.7	6.0	6.6	6.6
3.3 ≤ E < 3.5	5.3	5.5	6.4	6.6	5.9	6.5	6.5
3.5 ≤ E < 3.7	5.3	5.4	6.3	6.5	5.9	6.4	6.4
3.7 ≤ E < 3.9	5.2	5.3	6.2	6.5	5.8	6.3	6.3
3.9 ≤ E < 4.1	5.1	5.3	6.1	6.4	5.7	6.2	6.2
4.1 ≤ E < 4.3	5.0	5.2	6.0	6.3	5.7	6.2	6.1
4.3 ≤ E < 4.5	5.0	5.2	6.0	6.2	5.6	6.1	6.1
4.5 ≤ E < 4.7	5.0	5.1	5.9	6.2	5.6	6.0	6.0
4.7 ≤ E < 4.9	4.9	5.0	5.9	6.1	5.5	6.0	6.0
E ≥ 4.9	4.9	5.0	5.8	6.0	5.5	6.0	5.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.9	6.0	7.1	7.4	6.6	7.2	7.2
2.7 ≤ E < 2.9	5.8	5.9	7.0	7.3	6.5	7.0	7.0
2.9 ≤ E < 3.1	5.7	5.8	6.9	7.1	6.4	6.9	6.9
3.1 ≤ E < 3.3	5.6	5.8	6.8	7.0	6.2	6.8	6.8
3.3 ≤ E < 3.5	5.5	5.7	6.7	6.9	6.1	6.8	6.7
3.5 ≤ E < 3.7	5.5	5.6	6.6	6.8	6.0	6.7	6.7
3.7 ≤ E < 3.9	5.4	5.6	6.5	6.8	6.0	6.6	6.6
3.9 ≤ E < 4.1	5.3	5.5	6.4	6.7	5.9	6.5	6.5
4.1 ≤ E < 4.3	5.3	5.4	6.3	6.6	5.9	6.4	6.4
4.3 ≤ E < 4.5	5.2	5.4	6.2	6.5	5.8	6.4	6.4
4.5 ≤ E < 4.7	5.1	5.3	6.2	6.5	5.8	6.3	6.3
4.7 ≤ E < 4.9	5.1	5.3	6.1	6.4	5.7	6.2	6.2
E ≥ 4.9	5.0	5.2	6.0	6.3	5.7	6.2	6.2

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.0	6.2	7.3	7.7	6.7	7.4	7.4
2.9 ≤ E < 3.1	5.9	6.0	7.2	7.6	6.6	7.3	7.3
3.1 ≤ E < 3.3	5.8	6.0	7.0	7.4	6.5	7.2	7.1
3.3 ≤ E < 3.5	5.7	5.9	6.9	7.3	6.4	7.0	7.0
3.5 ≤ E < 3.7	5.7	5.8	6.8	7.2	6.3	6.9	6.9
3.7 ≤ E < 3.9	5.6	5.8	6.8	7.0	6.2	6.9	6.9
3.9 ≤ E < 4.1	5.5	5.7	6.7	7.0	6.2	6.8	6.8
4.1 ≤ E < 4.3	5.5	5.6	6.6	6.9	6.1	6.7	6.7
4.3 ≤ E < 4.5	5.4	5.6	6.5	6.8	6.0	6.7	6.6
4.5 ≤ E < 4.7	5.3	5.5	6.5	6.7	6.0	6.6	6.6
4.7 ≤ E < 4.9	5.3	5.5	6.4	6.7	5.9	6.5	6.5
E ≥ 4.9	5.2	5.4	6.3	6.6	5.9	6.5	6.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.2	6.5	7.7	8.1	7.0	7.8	7.8
2.9 ≤ E < 3.1	6.1	6.3	7.6	7.9	6.9	7.7	7.7
3.1 ≤ E < 3.3	6.0	6.2	7.4	7.8	6.8	7.5	7.5
3.3 ≤ E < 3.5	5.9	6.1	7.3	7.7	6.7	7.4	7.4
3.5 ≤ E < 3.7	5.9	6.0	7.2	7.6	6.6	7.3	7.3
3.7 ≤ E < 3.9	5.8	6.0	7.0	7.4	6.5	7.2	7.2
3.9 ≤ E < 4.1	5.7	5.9	7.0	7.3	6.4	7.1	7.1
4.1 ≤ E < 4.3	5.7	5.8	6.9	7.2	6.4	7.0	7.0
4.3 ≤ E < 4.5	5.6	5.8	6.8	7.1	6.3	6.9	6.9
4.5 ≤ E < 4.7	5.5	5.7	6.7	7.0	6.2	6.9	6.9
4.7 ≤ E < 4.9	5.5	5.7	6.7	7.0	6.2	6.8	6.8
E ≥ 4.9	5.4	5.6	6.6	6.9	6.1	6.7	6.7

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.5	6.8	8.1	8.6	7.4	8.2	8.2
2.9 ≤ E < 3.1	6.4	6.6	8.0	8.4	7.2	8.1	8.0
3.1 ≤ E < 3.3	6.3	6.5	7.8	8.3	7.1	7.9	7.9
3.3 ≤ E < 3.5	6.2	6.4	7.7	8.1	7.0	7.8	7.8
3.5 ≤ E < 3.7	6.1	6.3	7.6	7.9	6.9	7.7	7.7
3.7 ≤ E < 3.9	6.0	6.2	7.4	7.8	6.8	7.6	7.5
3.9 ≤ E < 4.1	5.9	6.1	7.3	7.7	6.7	7.5	7.4
4.1 ≤ E < 4.3	5.9	6.0	7.2	7.6	6.6	7.3	7.3
4.3 ≤ E < 4.5	5.8	6.0	7.1	7.5	6.6	7.3	7.2
4.5 ≤ E < 4.7	5.7	5.9	7.0	7.4	6.5	7.2	7.1
4.7 ≤ E < 4.9	5.7	5.9	7.0	7.3	6.4	7.1	7.1
E ≥ 4.9	5.6	5.8	6.9	7.3	6.4	7.0	7.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.8	7.0	8.6	9.2	7.8	8.7	8.7
2.9 ≤ E < 3.1	6.7	6.9	8.4	8.9	7.6	8.6	8.5
3.1 ≤ E < 3.3	6.6	6.8	8.2	8.8	7.5	8.4	8.4
3.3 ≤ E < 3.5	6.5	6.7	8.0	8.6	7.3	8.2	8.2
3.5 ≤ E < 3.7	6.3	6.6	7.9	8.4	7.2	8.0	8.0
3.7 ≤ E < 3.9	6.2	6.5	7.8	8.3	7.1	7.9	7.9
3.9 ≤ E < 4.1	6.1	6.4	7.7	8.1	7.0	7.8	7.8
4.1 ≤ E < 4.3	6.0	6.3	7.6	8.0	6.9	7.7	7.7
4.3 ≤ E < 4.5	6.0	6.2	7.5	7.9	6.8	7.6	7.6
4.5 ≤ E < 4.7	5.9	6.1	7.4	7.8	6.8	7.5	7.5
4.7 ≤ E < 4.9	5.9	6.1	7.3	7.7	6.7	7.5	7.4
E ≥ 4.9	5.8	6.0	7.2	7.6	6.6	7.4	7.4

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.1	7.4	9.2	9.8	8.2	9.3	9.3
2.9 ≤ E < 3.1	7.0	7.3	8.9	9.5	8.0	9.0	9.0
3.1 ≤ E < 3.3	6.9	7.1	8.7	9.3	7.9	8.9	8.8
3.3 ≤ E < 3.5	6.7	7.0	8.6	9.1	7.7	8.7	8.7
3.5 ≤ E < 3.7	6.6	6.9	8.4	8.9	7.6	8.5	8.5
3.7 ≤ E < 3.9	6.5	6.8	8.2	8.8	7.5	8.4	8.4
3.9 ≤ E < 4.1	6.4	6.7	8.1	8.6	7.3	8.2	8.2
4.1 ≤ E < 4.3	6.3	6.6	8.0	8.5	7.2	8.1	8.1
4.3 ≤ E < 4.5	6.2	6.5	7.9	8.3	7.1	8.0	8.0
4.5 ≤ E < 4.7	6.1	6.4	7.8	8.2	7.0	7.9	7.9
4.7 ≤ E < 4.9	6.1	6.3	7.7	8.1	7.0	7.8	7.8
E ≥ 4.9	6.0	6.3	7.6	8.0	6.9	7.7	7.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.3	7.5	9.5	10.2	8.5	9.6	9.6
3.1 ≤ E < 3.3	7.2	7.4	9.3	9.9	8.3	9.4	9.4
3.3 ≤ E < 3.5	7.0	7.2	9.0	9.7	8.1	9.2	9.2
3.5 ≤ E < 3.7	6.9	7.1	8.9	9.5	8.0	9.0	9.0
3.7 ≤ E < 3.9	6.8	7.0	8.7	9.3	7.8	8.9	8.8
3.9 ≤ E < 4.1	6.7	6.9	8.6	9.1	7.7	8.7	8.7
4.1 ≤ E < 4.3	6.6	6.8	8.4	9.0	7.6	8.6	8.6
4.3 ≤ E < 4.5	6.5	6.7	8.3	8.8	7.5	8.4	8.4
4.5 ≤ E < 4.7	6.4	6.6	8.2	8.7	7.4	8.3	8.3
4.7 ≤ E < 4.9	6.3	6.5	8.0	8.6	7.3	8.2	8.2
E ≥ 4.9	6.3	6.5	7.9	8.5	7.2	8.1	8.1

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ²³⁵U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.6	7.9	10.1	11.0	9.0	10.3	10.2
3.1 ≤ E < 3.3	7.4	7.8	9.9	10.6	8.8	10.0	10.0
3.3 ≤ E < 3.5	7.2	7.6	9.6	10.4	8.6	9.8	9.8
3.5 ≤ E < 3.7	7.1	7.4	9.4	10.1	8.4	9.6	9.6
3.7 ≤ E < 3.9	7.0	7.3	9.2	9.9	8.2	9.4	9.4
3.9 ≤ E < 4.1	6.9	7.2	9.0	9.7	8.1	9.2	9.2
4.1 ≤ E < 4.3	6.8	7.0	8.9	9.5	8.0	9.0	9.0
4.3 ≤ E < 4.5	6.7	7.0	8.8	9.4	7.9	8.9	8.9
4.5 ≤ E < 4.7	6.6	6.9	8.6	9.2	7.8	8.8	8.8
4.7 ≤ E < 4.9	6.5	6.8	8.5	9.1	7.7	8.7	8.7
E ≥ 4.9	6.4	6.7	8.4	9.0	7.6	8.6	8.6
Minimum Initial Assembly Avg. Enrichment wt % ²³⁵U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.9	8.3	10.9	11.4	9.5	11.0	11.0
3.1 ≤ E < 3.3	7.8	8.1	10.6	11.1	9.3	10.7	10.7
3.3 ≤ E < 3.5	7.6	8.0	10.3	10.8	9.0	10.4	10.4
3.5 ≤ E < 3.7	7.4	7.8	10.0	10.6	8.9	10.2	10.2
3.7 ≤ E < 3.9	7.3	7.7	9.8	10.3	8.7	10.0	9.9
3.9 ≤ E < 4.1	7.2	7.5	9.6	10.1	8.5	9.8	9.8
4.1 ≤ E < 4.3	7.0	7.4	9.4	9.9	8.4	9.6	9.6
4.3 ≤ E < 4.5	6.9	7.3	9.3	9.8	8.3	9.5	9.4
4.5 ≤ E < 4.7	6.9	7.2	9.1	9.6	8.1	9.3	9.3
4.7 ≤ E < 4.9	6.8	7.1	9.0	9.5	8.0	9.2	9.1
E ≥ 4.9	6.7	7.0	8.9	9.3	7.9	9.0	9.0

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.4	8.8	11.3	12.2	10.1	11.7	11.7
3.1 ≤ E < 3.3	8.1	8.6	11.0	11.9	9.9	11.4	11.4
3.3 ≤ E < 3.5	8.0	8.4	10.7	11.6	9.6	11.2	11.2
3.5 ≤ E < 3.7	7.8	8.2	10.4	11.3	9.4	10.9	10.9
3.7 ≤ E < 3.9	7.7	8.1	10.2	11.1	9.2	10.7	10.6
3.9 ≤ E < 4.1	7.5	7.9	9.9	10.8	9.0	10.4	10.4
4.1 ≤ E < 4.3	7.4	7.8	9.8	10.6	8.8	10.2	10.2
4.3 ≤ E < 4.5	7.3	7.7	9.6	10.4	8.7	10.0	10.0
4.5 ≤ E < 4.7	7.1	7.6	9.5	10.2	8.6	9.9	9.8
4.7 ≤ E < 4.9	7.0	7.4	9.3	10.0	8.5	9.7	9.7
E ≥ 4.9	7.0	7.3	9.2	9.9	8.3	9.6	9.6
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.8	9.3	12.0	13.1	10.8	12.5	12.5
3.1 ≤ E < 3.3	8.6	9.1	11.7	12.7	10.5	12.2	12.1
3.3 ≤ E < 3.5	8.4	8.9	11.4	12.3	10.2	11.9	11.9
3.5 ≤ E < 3.7	8.2	8.7	11.1	12.0	10.0	11.6	11.6
3.7 ≤ E < 3.9	8.0	8.5	10.9	11.8	9.8	11.4	11.4
3.9 ≤ E < 4.1	7.9	8.3	10.6	11.5	9.6	11.1	11.1
4.1 ≤ E < 4.3	7.7	8.2	10.4	11.3	9.4	10.9	10.9
4.3 ≤ E < 4.5	7.6	8.0	10.2	11.1	9.2	10.7	10.7
4.5 ≤ E < 4.7	7.5	7.9	10.0	10.9	9.0	10.5	10.5
4.7 ≤ E < 4.9	7.4	7.8	9.9	10.7	8.9	10.3	10.3
E ≥ 4.9	7.3	7.9	9.7	10.6	8.8	10.2	10.1

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly(continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	9.1	9.7	12.5	13.6	11.2	13.0	13.0
3.3 ≤ E < 3.5	8.8	9.4	12.1	13.2	10.9	12.7	12.7
3.5 ≤ E < 3.7	8.7	9.2	11.8	12.9	10.7	12.4	12.4
3.7 ≤ E < 3.9	8.5	9.0	11.6	12.6	10.4	12.1	12.0
3.9 ≤ E < 4.1	8.3	8.8	11.3	12.2	10.1	11.8	11.8
4.1 ≤ E < 4.3	8.1	8.6	11.1	12.0	9.9	11.6	11.6
4.3 ≤ E < 4.5	8.0	8.5	10.9	11.8	9.7	11.4	11.4
4.5 ≤ E < 4.7	7.9	8.3	10.7	11.6	9.6	11.2	11.2
4.7 ≤ E < 4.9	7.7	8.2	10.5	11.4	9.4	11.0	11.0
E ≥ 4.9	7.6	8.1	10.3	11.3	9.3	10.9	10.8
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	9.6	10.3	13.3	14.5	11.6	13.9	13.9
3.3 ≤ E < 3.5	9.4	10.0	13.0	14.1	11.3	13.6	13.5
3.5 ≤ E < 3.7	9.1	9.7	12.6	13.8	11.0	13.3	13.2
3.7 ≤ E < 3.9	8.9	9.5	12.3	13.4	10.8	12.9	12.9
3.9 ≤ E < 4.1	8.7	9.3	12.0	13.2	10.5	12.7	12.6
4.1 ≤ E < 4.3	8.6	9.1	11.8	12.9	10.3	12.4	12.3
4.3 ≤ E < 4.5	8.4	8.9	11.6	12.6	10.0	12.1	12.1
4.5 ≤ E < 4.7	8.2	8.8	11.4	12.4	9.9	11.9	11.9
4.7 ≤ E < 4.9	8.1	8.6	11.2	12.2	9.7	11.7	11.7
E ≥ 4.9	8.0	8.5	11.0	12.0	9.6	11.5	11.5

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	10.2	10.9	14.2	15.4	12.4	14.9	14.8
3.3 ≤ E < 3.5	9.9	10.7	13.8	15.0	12.0	14.5	14.4
3.5 ≤ E < 3.7	9.6	10.3	13.4	14.7	11.7	14.1	14.0
3.7 ≤ E < 3.9	9.4	10.0	13.1	14.3	11.4	13.8	13.7
3.9 ≤ E < 4.1	9.2	9.8	12.8	14.0	11.2	13.5	13.4
4.1 ≤ E < 4.3	9.0	9.6	12.5	13.7	10.9	13.2	13.2
4.3 ≤ E < 4.5	8.8	9.4	12.3	13.5	10.7	13.0	12.9
4.5 ≤ E < 4.7	8.7	9.3	12.0	13.2	10.5	12.7	12.7
4.7 ≤ E < 4.9	8.5	9.1	11.8	13.0	10.3	12.4	12.4
E ≥ 4.9	8.4	8.9	11.6	12.8	10.1	12.2	12.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	10.8	11.6	15.1	16.4	13.2	15.8	15.8
3.3 ≤ E < 3.5	10.5	11.3	14.7	16.0	12.8	15.4	15.4
3.5 ≤ E < 3.7	10.2	11.0	14.3	15.6	12.4	15.0	15.0
3.7 ≤ E < 3.9	9.9	10.7	14.0	15.3	12.1	14.7	14.6
3.9 ≤ E < 4.1	9.7	10.5	13.7	14.9	11.8	14.3	14.3
4.1 ≤ E < 4.3	9.5	10.2	13.4	14.6	11.6	14.0	14.0
4.3 ≤ E < 4.5	9.3	10.0	13.1	14.3	11.4	13.8	13.7
4.5 ≤ E < 4.7	9.1	9.8	12.8	14.0	11.1	13.5	13.5
4.7 ≤ E < 4.9	8.9	9.6	12.6	13.8	11.0	13.3	13.3
E ≥ 4.9	8.8	9.4	12.4	13.6	10.8	13.0	13.0

Table 5.8.9-2 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	11.5	12.4	16.0	17.4	14.0	16.7	16.7
3.3 ≤ E < 3.5	11.2	12.0	15.6	17.0	13.6	16.3	16.3
3.5 ≤ E < 3.7	10.8	11.7	15.2	16.6	13.2	16.0	15.9
3.7 ≤ E < 3.9	10.6	11.4	14.9	16.2	12.9	15.6	15.6
3.9 ≤ E < 4.1	10.3	11.1	14.5	15.9	12.6	15.3	15.3
4.1 ≤ E < 4.3	10.0	10.9	14.2	15.5	12.3	14.9	14.9
4.3 ≤ E < 4.5	9.8	10.6	13.9	15.3	12.0	14.7	14.6
4.5 ≤ E < 4.7	9.6	10.4	13.7	15.0	11.8	14.4	14.3
4.7 ≤ E < 4.9	9.4	10.2	13.4	14.7	11.6	14.1	14.1
E ≥ 4.9	9.3	10.0	13.2	14.4	11.4	13.9	13.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	11.8	12.8	16.5	17.9	14.4	16.9	16.8
3.5 ≤ E < 3.7	11.5	12.4	16.1	17.6	14.0	16.5	16.4
3.7 ≤ E < 3.9	11.2	12.0	15.8	17.2	13.7	16.1	16.0
3.9 ≤ E < 4.1	10.9	11.8	15.4	16.8	13.4	15.8	15.7
4.1 ≤ E < 4.3	10.7	11.5	15.1	16.5	13.1	15.4	15.4
4.3 ≤ E < 4.5	10.4	11.3	14.8	16.1	12.8	15.1	15.1
4.5 ≤ E < 4.7	10.1	11.1	14.5	15.9	12.5	14.9	14.8
4.7 ≤ E < 4.9	10.0	10.8	14.2	15.6	12.3	14.6	14.6
E ≥ 4.9	9.8	10.6	13.9	15.4	12.0	14.3	14.3

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.3 ≤ E < 2.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.5 ≤ E < 2.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.7 ≤ E < 2.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.9 ≤ E < 3.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.1 ≤ E < 3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.3 ≤ E < 3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.0	4.0	4.0	4.1	4.0	4.1	4.1
2.5 ≤ E < 2.7	4.0	4.0	4.0	4.1	4.0	4.0	4.0
2.7 ≤ E < 2.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.9 ≤ E < 3.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.1 ≤ E < 3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.3 ≤ E < 3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.0	4.0	4.3	4.4	4.2	4.4	4.4
2.5 ≤ E < 2.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
2.7 ≤ E < 2.9	4.0	4.0	4.2	4.3	4.1	4.3	4.3
2.9 ≤ E < 3.1	4.0	4.0	4.2	4.3	4.0	4.3	4.3
3.1 ≤ E < 3.3	4.0	4.0	4.1	4.2	4.0	4.2	4.2
3.3 ≤ E < 3.5	4.0	4.0	4.1	4.2	4.0	4.2	4.2
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.2	4.0	4.2	4.2
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.1	4.0	4.1	4.1
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.1	4.0	4.1	4.1
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.0	4.1	4.6	4.8	4.4	4.7	4.7
2.7 ≤ E < 2.9	4.0	4.0	4.6	4.7	4.4	4.7	4.7
2.9 ≤ E < 3.1	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.1 ≤ E < 3.3	4.0	4.0	4.5	4.6	4.3	4.5	4.5
3.3 ≤ E < 3.5	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.5 ≤ E < 3.7	4.0	4.0	4.4	4.5	4.2	4.5	4.4
3.7 ≤ E < 3.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
3.9 ≤ E < 4.1	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.1 ≤ E < 4.3	4.0	4.0	4.2	4.3	4.1	4.3	4.3
4.3 ≤ E < 4.5	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.5 ≤ E < 4.7	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.7 ≤ E < 4.9	4.0	4.0	4.1	4.3	4.0	4.3	4.3
E ≥ 4.9	4.0	4.0	4.1	4.2	4.0	4.2	4.2

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.2	4.2	4.8	4.9	4.5	4.9	4.9
2.7 ≤ E < 2.9	4.1	4.2	4.7	4.8	4.5	4.8	4.8
2.9 ≤ E < 3.1	4.0	4.1	4.7	4.8	4.4	4.8	4.7
3.1 ≤ E < 3.3	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.3 ≤ E < 3.5	4.0	4.0	4.5	4.7	4.4	4.6	4.6
3.5 ≤ E < 3.7	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.7 ≤ E < 3.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.9 ≤ E < 4.1	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.1 ≤ E < 4.3	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.3 ≤ E < 4.5	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.5 ≤ E < 4.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.7 ≤ E < 4.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
E ≥ 4.9	4.0	4.0	4.2	4.3	4.0	4.4	4.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.3	4.4	4.9	5.1	4.7	5.0	5.0
2.7 ≤ E < 2.9	4.2	4.3	4.9	5.0	4.6	5.0	5.0
2.9 ≤ E < 3.1	4.2	4.2	4.8	4.9	4.6	4.9	4.9
3.1 ≤ E < 3.3	4.1	4.2	4.7	4.9	4.5	4.8	4.8
3.3 ≤ E < 3.5	4.0	4.1	4.7	4.8	4.5	4.8	4.8
3.5 ≤ E < 3.7	4.0	4.1	4.6	4.8	4.4	4.7	4.7
3.7 ≤ E < 3.9	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.9 ≤ E < 4.1	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.1 ≤ E < 4.3	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.3 ≤ E < 4.5	4.0	4.0	4.4	4.6	4.3	4.5	4.5
4.5 ≤ E < 4.7	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.7 ≤ E < 4.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5
E ≥ 4.9	4.0	4.0	4.3	4.5	4.2	4.5	4.5

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.4	4.5	5.1	5.3	4.9	5.2	5.2
2.7 ≤ E < 2.9	4.4	4.4	5.0	5.2	4.8	5.1	5.1
2.9 ≤ E < 3.1	4.3	4.4	5.0	5.1	4.7	5.0	5.0
3.1 ≤ E < 3.3	4.2	4.3	4.9	5.0	4.7	5.0	5.0
3.3 ≤ E < 3.5	4.2	4.3	4.8	5.0	4.6	4.9	4.9
3.5 ≤ E < 3.7	4.1	4.2	4.8	4.9	4.5	4.9	4.9
3.7 ≤ E < 3.9	4.1	4.2	4.7	4.9	4.5	4.8	4.8
3.9 ≤ E < 4.1	4.0	4.1	4.7	4.8	4.4	4.8	4.8
4.1 ≤ E < 4.3	4.0	4.1	4.6	4.8	4.4	4.7	4.7
4.3 ≤ E < 4.5	4.0	4.0	4.6	4.7	4.4	4.7	4.7
4.5 ≤ E < 4.7	4.0	4.0	4.5	4.7	4.3	4.7	4.6
4.7 ≤ E < 4.9	4.0	4.0	4.5	4.6	4.3	4.6	4.6
E ≥ 4.9	4.0	4.0	4.4	4.6	4.3	4.6	4.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
2.7 ≤ E < 2.9	4.5	4.6	5.2	5.4	4.9	5.3	5.3
2.9 ≤ E < 3.1	4.4	4.5	5.1	5.3	4.9	5.2	5.2
3.1 ≤ E < 3.3	4.4	4.4	5.0	5.2	4.8	5.2	5.2
3.3 ≤ E < 3.5	4.3	4.4	5.0	5.1	4.7	5.1	5.1
3.5 ≤ E < 3.7	4.2	4.3	4.9	5.1	4.7	5.0	5.0
3.7 ≤ E < 3.9	4.2	4.3	4.9	5.0	4.6	5.0	5.0
3.9 ≤ E < 4.1	4.1	4.3	4.8	5.0	4.6	4.9	4.9
4.1 ≤ E < 4.3	4.1	4.2	4.8	4.9	4.5	4.9	4.9
4.3 ≤ E < 4.5	4.1	4.2	4.7	4.9	4.5	4.8	4.8
4.5 ≤ E < 4.7	4.0	4.2	4.7	4.8	4.5	4.8	4.8
4.7 ≤ E < 4.9	4.0	4.1	4.6	4.8	4.4	4.8	4.7
E ≥ 4.9	4.0	4.1	4.6	4.8	4.4	4.7	4.7

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	4.6	4.7	5.4	5.6	5.1	5.5	5.5
2.9 ≤ E < 3.1	4.5	4.6	5.3	5.5	5.0	5.4	5.4
3.1 ≤ E < 3.3	4.5	4.6	5.2	5.4	4.9	5.4	5.4
3.3 ≤ E < 3.5	4.4	4.5	5.2	5.4	4.9	5.3	5.3
3.5 ≤ E < 3.7	4.4	4.5	5.1	5.3	4.8	5.2	5.2
3.7 ≤ E < 3.9	4.3	4.4	5.0	5.2	4.8	5.1	5.1
3.9 ≤ E < 4.1	4.3	4.4	5.0	5.1	4.7	5.1	5.1
4.1 ≤ E < 4.3	4.2	4.3	4.9	5.1	4.7	5.0	5.0
4.3 ≤ E < 4.5	4.2	4.3	4.9	5.0	4.6	5.0	5.0
4.5 ≤ E < 4.7	4.1	4.2	4.8	5.0	4.6	4.9	4.9
4.7 ≤ E < 4.9	4.1	4.2	4.8	4.9	4.5	4.9	4.9
E ≥ 4.9	4.0	4.2	4.7	4.9	4.5	4.9	4.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	4.8	4.9	5.6	5.8	5.3	5.7	5.7
2.9 ≤ E < 3.1	4.7	4.8	5.5	5.7	5.2	5.6	5.6
3.1 ≤ E < 3.3	4.6	4.7	5.5	5.6	5.1	5.6	5.5
3.3 ≤ E < 3.5	4.5	4.7	5.4	5.6	5.0	5.5	5.5
3.5 ≤ E < 3.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
3.7 ≤ E < 3.9	4.4	4.5	5.2	5.4	4.9	5.3	5.3
3.9 ≤ E < 4.1	4.4	4.5	5.1	5.3	4.9	5.3	5.3
4.1 ≤ E < 4.3	4.4	4.4	5.1	5.3	4.8	5.2	5.2
4.3 ≤ E < 4.5	4.3	4.4	5.0	5.2	4.8	5.1	5.1
4.5 ≤ E < 4.7	4.3	4.4	5.0	5.1	4.7	5.1	5.1
4.7 ≤ E < 4.9	4.2	4.3	4.9	5.1	4.7	5.0	5.0
E ≥ 4.9	4.2	4.3	4.9	5.0	4.6	5.0	5.0

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	4.9	5.0	5.8	6.0	5.5	5.9	5.9
2.9 ≤ E < 3.1	4.8	4.9	5.7	5.9	5.4	5.8	5.8
3.1 ≤ E < 3.3	4.8	4.9	5.7	5.8	5.3	5.7	5.8
3.3 ≤ E < 3.5	4.7	4.8	5.6	5.7	5.2	5.7	5.7
3.5 ≤ E < 3.7	4.6	4.7	5.5	5.7	5.1	5.6	5.6
3.7 ≤ E < 3.9	4.6	4.7	5.4	5.6	5.1	5.5	5.5
3.9 ≤ E < 4.1	4.5	4.6	5.3	5.5	5.0	5.5	5.5
4.1 ≤ E < 4.3	4.5	4.6	5.3	5.5	4.9	5.4	5.4
4.3 ≤ E < 4.5	4.4	4.5	5.2	5.4	4.9	5.3	5.3
4.5 ≤ E < 4.7	4.4	4.5	5.1	5.3	4.9	5.3	5.2
4.7 ≤ E < 4.9	4.3	4.4	5.1	5.3	4.8	5.2	5.2
E ≥ 4.9	4.3	4.4	5.0	5.2	4.8	5.2	5.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	5.1	5.2	6.0	6.3	5.7	6.1	6.1
2.9 ≤ E < 3.1	5.0	5.1	5.9	6.1	5.6	6.0	6.0
3.1 ≤ E < 3.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.3 ≤ E < 3.5	4.8	5.0	5.8	5.9	5.4	5.9	5.9
3.5 ≤ E < 3.7	4.8	4.9	5.7	5.9	5.3	5.8	5.8
3.7 ≤ E < 3.9	4.7	4.8	5.6	5.8	5.3	5.7	5.7
3.9 ≤ E < 4.1	4.7	4.8	5.5	5.7	5.2	5.7	5.6
4.1 ≤ E < 4.3	4.6	4.7	5.5	5.7	5.1	5.6	5.6
4.3 ≤ E < 4.5	4.5	4.7	5.4	5.6	5.0	5.5	5.5
4.5 ≤ E < 4.7	4.5	4.6	5.3	5.6	5.0	5.5	5.5
4.7 ≤ E < 4.9	4.5	4.6	5.3	5.5	4.9	5.4	5.4
E ≥ 4.9	4.4	4.5	5.2	5.4	4.9	5.4	5.3

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	5.3	5.4	6.3	6.6	5.9	6.4	6.4
2.9 ≤ E < 3.1	5.2	5.3	6.2	6.4	5.8	6.3	6.3
3.1 ≤ E < 3.3	5.1	5.2	6.0	6.3	5.7	6.1	6.1
3.3 ≤ E < 3.5	5.0	5.1	6.0	6.2	5.6	6.0	6.0
3.5 ≤ E < 3.7	4.9	5.0	5.9	6.1	5.5	6.0	6.0
3.7 ≤ E < 3.9	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.9 ≤ E < 4.1	4.8	4.9	5.7	5.9	5.4	5.8	5.8
4.1 ≤ E < 4.3	4.7	4.9	5.7	5.9	5.3	5.8	5.8
4.3 ≤ E < 4.5	4.7	4.8	5.6	5.8	5.2	5.7	5.7
4.5 ≤ E < 4.7	4.6	4.8	5.5	5.7	5.2	5.7	5.7
4.7 ≤ E < 4.9	4.5	4.7	5.5	5.7	5.1	5.6	5.6
E ≥ 4.9	4.5	4.6	5.4	5.6	5.0	5.5	5.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.4	5.5	6.4	6.7	6.0	6.5	6.5
3.1 ≤ E < 3.3	5.3	5.4	6.3	6.6	5.9	6.4	6.4
3.3 ≤ E < 3.5	5.2	5.3	6.2	6.5	5.8	6.3	6.3
3.5 ≤ E < 3.7	5.1	5.2	6.1	6.4	5.7	6.2	6.2
3.7 ≤ E < 3.9	5.0	5.1	6.0	6.2	5.6	6.1	6.1
3.9 ≤ E < 4.1	4.9	5.0	5.9	6.1	5.6	6.0	6.0
4.1 ≤ E < 4.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
4.3 ≤ E < 4.5	4.8	4.9	5.8	6.0	5.4	5.9	5.9
4.5 ≤ E < 4.7	4.8	4.9	5.7	5.9	5.3	5.8	5.8
4.7 ≤ E < 4.9	4.7	4.8	5.7	5.9	5.3	5.8	5.8
E ≥ 4.9	4.7	4.8	5.6	5.8	5.2	5.7	5.7

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.5	5.7	6.7	7.0	6.2	6.8	6.8
3.1 ≤ E < 3.3	5.4	5.6	6.6	6.9	6.1	6.7	6.7
3.3 ≤ E < 3.5	5.3	5.5	6.5	6.7	6.0	6.6	6.6
3.5 ≤ E < 3.7	5.2	5.4	6.3	6.6	5.9	6.5	6.5
3.7 ≤ E < 3.9	5.1	5.3	6.2	6.5	5.8	6.4	6.4
3.9 ≤ E < 4.1	5.0	5.2	6.1	6.4	5.7	6.3	6.3
4.1 ≤ E < 4.3	5.0	5.1	6.0	6.3	5.7	6.2	6.2
4.3 ≤ E < 4.5	4.9	5.0	6.0	6.2	5.6	6.1	6.1
4.5 ≤ E < 4.7	4.9	5.0	5.9	6.1	5.5	6.0	6.0
4.7 ≤ E < 4.9	4.8	4.9	5.8	6.0	5.5	6.0	6.0
E ≥ 4.9	4.8	4.9	5.8	6.0	5.4	5.9	5.9
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.7	5.8	7.0	7.2	6.5	7.1	7.1
3.1 ≤ E < 3.3	5.6	5.7	6.8	7.0	6.3	7.0	6.9
3.3 ≤ E < 3.5	5.5	5.7	6.7	6.9	6.2	6.8	6.8
3.5 ≤ E < 3.7	5.4	5.6	6.6	6.8	6.1	6.7	6.7
3.7 ≤ E < 3.9	5.3	5.5	6.5	6.7	6.0	6.6	6.6
3.9 ≤ E < 4.1	5.2	5.4	6.4	6.6	5.9	6.5	6.5
4.1 ≤ E < 4.3	5.1	5.3	6.3	6.5	5.9	6.4	6.4
4.3 ≤ E < 4.5	5.0	5.2	6.2	6.4	5.8	6.3	6.3
4.5 ≤ E < 4.7	5.0	5.2	6.1	6.3	5.7	6.3	6.2
4.7 ≤ E < 4.9	4.9	5.1	6.0	6.2	5.7	6.2	6.2
E ≥ 4.9	4.9	5.0	6.0	6.1	5.6	6.1	6.1

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.9	6.0	7.2	7.6	6.7	7.4	7.4
3.1 ≤ E < 3.3	5.8	5.9	7.0	7.4	6.6	7.3	7.3
3.3 ≤ E < 3.5	5.7	5.8	6.9	7.2	6.5	7.1	7.1
3.5 ≤ E < 3.7	5.6	5.8	6.8	7.1	6.4	7.0	7.0
3.7 ≤ E < 3.9	5.5	5.7	6.7	7.0	6.2	6.9	6.9
3.9 ≤ E < 4.1	5.4	5.6	6.6	6.9	6.1	6.8	6.8
4.1 ≤ E < 4.3	5.3	5.5	6.5	6.8	6.0	6.7	6.7
4.3 ≤ E < 4.5	5.2	5.4	6.4	6.7	6.0	6.6	6.6
4.5 ≤ E < 4.7	5.2	5.4	6.3	6.6	5.9	6.5	6.5
4.7 ≤ E < 4.9	5.1	5.3	6.2	6.5	5.8	6.4	6.4
E ≥ 4.9	5.0	5.2	6.1	6.4	5.8	6.3	6.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	6.0	6.3	7.5	7.9	7.0	7.8	7.8
3.1 ≤ E < 3.3	5.9	6.1	7.4	7.8	6.9	7.6	7.6
3.3 ≤ E < 3.5	5.8	6.0	7.2	7.6	6.7	7.5	7.5
3.5 ≤ E < 3.7	5.8	5.9	7.0	7.4	6.6	7.3	7.3
3.7 ≤ E < 3.9	5.7	5.9	6.9	7.3	6.5	7.2	7.2
3.9 ≤ E < 4.1	5.6	5.8	6.8	7.1	6.4	7.0	7.0
4.1 ≤ E < 4.3	5.5	5.7	6.7	7.0	6.3	6.9	6.9
4.3 ≤ E < 4.5	5.4	5.6	6.6	6.9	6.2	6.9	6.8
4.5 ≤ E < 4.7	5.3	5.6	6.5	6.8	6.1	6.8	6.8
4.7 ≤ E < 4.9	5.3	5.5	6.4	6.8	6.0	6.7	6.7
E ≥ 4.9	5.2	5.5	6.4	6.7	6.0	6.6	6.6

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	6.2	6.4	7.7	8.1	7.1	8.0	8.0
3.3 ≤ E < 3.5	6.0	6.3	7.5	7.9	7.0	7.8	7.8
3.5 ≤ E < 3.7	5.9	6.2	7.4	7.8	6.9	7.7	7.7
3.7 ≤ E < 3.9	5.9	6.0	7.2	7.6	6.8	7.5	7.5
3.9 ≤ E < 4.1	5.8	6.0	7.1	7.5	6.7	7.4	7.4
4.1 ≤ E < 4.3	5.7	5.9	7.0	7.4	6.6	7.2	7.2
4.3 ≤ E < 4.5	5.6	5.8	6.9	7.2	6.5	7.1	7.1
4.5 ≤ E < 4.7	5.6	5.7	6.8	7.1	6.3	7.0	7.0
4.7 ≤ E < 4.9	5.5	5.7	6.7	7.0	6.3	6.9	6.9
E ≥ 4.9	5.4	5.6	6.6	6.9	6.2	6.9	6.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	6.4	6.7	8.1	8.6	7.3	8.4	8.4
3.3 ≤ E < 3.5	6.3	6.6	7.9	8.4	7.2	8.2	8.2
3.5 ≤ E < 3.7	6.2	6.4	7.7	8.2	7.0	8.0	8.0
3.7 ≤ E < 3.9	6.0	6.3	7.6	8.0	6.9	7.9	7.9
3.9 ≤ E < 4.1	6.0	6.2	7.4	7.9	6.8	7.7	7.7
4.1 ≤ E < 4.3	5.9	6.1	7.3	7.7	6.7	7.6	7.6
4.3 ≤ E < 4.5	5.8	6.0	7.2	7.6	6.6	7.5	7.4
4.5 ≤ E < 4.7	5.7	5.9	7.0	7.5	6.5	7.3	7.3
4.7 ≤ E < 4.9	5.6	5.8	6.9	7.4	6.4	7.2	7.2
E ≥ 4.9	5.6	5.8	6.9	7.2	6.3	7.1	7.1

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	6.7	6.9	8.5	9.0	7.7	8.8	8.8
3.3 ≤ E < 3.5	6.6	6.8	8.3	8.8	7.5	8.6	8.6
3.5 ≤ E < 3.7	6.4	6.7	8.1	8.6	7.3	8.4	8.4
3.7 ≤ E < 3.9	6.3	6.6	7.9	8.4	7.2	8.2	8.2
3.9 ≤ E < 4.1	6.2	6.5	7.8	8.2	7.0	8.1	8.0
4.1 ≤ E < 4.3	6.0	6.3	7.6	8.1	6.9	7.9	7.9
4.3 ≤ E < 4.5	6.0	6.2	7.5	7.9	6.8	7.8	7.8
4.5 ≤ E < 4.7	5.9	6.1	7.4	7.8	6.7	7.7	7.7
4.7 ≤ E < 4.9	5.8	6.0	7.2	7.7	6.6	7.6	7.5
E ≥ 4.9	5.8	6.0	7.1	7.6	6.6	7.5	7.4

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	7.0	7.3	9.0	9.6	8.0	9.3	9.3
3.3 ≤ E < 3.5	6.8	7.1	8.7	9.3	7.9	9.1	9.0
3.5 ≤ E < 3.7	6.7	6.9	8.5	9.1	7.7	8.9	8.9
3.7 ≤ E < 3.9	6.5	6.8	8.3	8.9	7.5	8.7	8.7
3.9 ≤ E < 4.1	6.4	6.7	8.1	8.7	7.4	8.5	8.5
4.1 ≤ E < 4.3	6.3	6.6	8.0	8.5	7.2	8.3	8.3
4.3 ≤ E < 4.5	6.2	6.5	7.8	8.3	7.1	8.2	8.1
4.5 ≤ E < 4.7	6.1	6.4	7.7	8.2	7.0	8.0	8.0
4.7 ≤ E < 4.9	6.0	6.3	7.6	8.0	6.9	7.9	7.9
E ≥ 4.9	5.9	6.2	7.5	7.9	6.8	7.8	7.8

Table 5.8.9-3 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	7.3	7.6	9.5	10.1	8.4	9.9	9.8
3.3 ≤ E < 3.5	7.1	7.4	9.2	9.9	8.2	9.6	9.6
3.5 ≤ E < 3.7	6.9	7.3	9.0	9.6	8.0	9.4	9.3
3.7 ≤ E < 3.9	6.8	7.1	8.8	9.4	7.9	9.1	9.1
3.9 ≤ E < 4.1	6.7	7.0	8.6	9.1	7.7	8.9	8.9
4.1 ≤ E < 4.3	6.6	6.8	8.4	8.9	7.6	8.7	8.7
4.3 ≤ E < 4.5	6.4	6.7	8.2	8.8	7.4	8.6	8.6
4.5 ≤ E < 4.7	6.3	6.6	8.0	8.6	7.3	8.4	8.4
4.7 ≤ E < 4.9	6.2	6.5	7.9	8.4	7.2	8.3	8.3
E ≥ 4.9	6.1	6.4	7.8	8.3	7.0	8.1	8.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	7.4	7.8	9.7	10.5	8.7	9.9	9.9
3.5 ≤ E < 3.7	7.2	7.6	9.5	10.1	8.4	9.6	9.6
3.7 ≤ E < 3.9	7.0	7.4	9.2	9.9	8.2	9.4	9.4
3.9 ≤ E < 4.1	6.9	7.3	9.0	9.7	8.0	9.2	9.1
4.1 ≤ E < 4.3	6.8	7.1	8.8	9.4	7.9	9.0	9.0
4.3 ≤ E < 4.5	6.7	7.0	8.6	9.2	7.7	8.8	8.8
4.5 ≤ E < 4.7	6.6	6.9	8.5	9.0	7.6	8.7	8.6
4.7 ≤ E < 4.9	6.5	6.8	8.3	8.9	7.5	8.5	8.5
E ≥ 4.9	6.4	6.7	8.1	8.7	7.4	8.4	8.3

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.2	4.3	4.8	4.9	4.6	4.9	4.9
2.3 ≤ E < 2.5	4.2	4.2	4.7	4.8	4.5	4.8	4.8
2.5 ≤ E < 2.7	4.1	4.2	4.7	4.8	4.5	4.8	4.8
2.7 ≤ E < 2.9	4.1	4.1	4.6	4.7	4.4	4.7	4.7
2.9 ≤ E < 3.1	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.1 ≤ E < 3.3	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.3 ≤ E < 3.5	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.5 ≤ E < 3.7	4.0	4.0	4.5	4.5	4.3	4.5	4.5
3.7 ≤ E < 3.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.9 ≤ E < 4.1	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.1 ≤ E < 4.3	4.0	4.0	4.4	4.5	4.2	4.4	4.4
4.3 ≤ E < 4.5	4.0	4.0	4.3	4.4	4.2	4.4	4.4
4.5 ≤ E < 4.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.7 ≤ E < 4.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
E ≥ 4.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.5	4.6	5.2	5.3	4.9	5.3	5.3
2.5 ≤ E < 2.7	4.4	4.5	5.1	5.3	4.9	5.2	5.2
2.7 ≤ E < 2.9	4.4	4.5	5.0	5.2	4.8	5.1	5.1
2.9 ≤ E < 3.1	4.4	4.4	5.0	5.1	4.8	5.1	5.1
3.1 ≤ E < 3.3	4.3	4.4	4.9	5.0	4.7	5.0	5.0
3.3 ≤ E < 3.5	4.3	4.3	4.9	5.0	4.7	5.0	5.0
3.5 ≤ E < 3.7	4.2	4.3	4.8	5.0	4.6	4.9	4.9
3.7 ≤ E < 3.9	4.2	4.3	4.8	4.9	4.6	4.9	4.9
3.9 ≤ E < 4.1	4.1	4.2	4.8	4.9	4.5	4.9	4.9
4.1 ≤ E < 4.3	4.1	4.2	4.7	4.9	4.5	4.8	4.8
4.3 ≤ E < 4.5	4.1	4.2	4.7	4.8	4.5	4.8	4.8
4.5 ≤ E < 4.7	4.0	4.1	4.7	4.8	4.5	4.8	4.8
4.7 ≤ E < 4.9	4.0	4.1	4.6	4.8	4.4	4.7	4.7
E ≥ 4.9	4.0	4.1	4.6	4.7	4.4	4.7	4.7

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.9	5.0	5.7	5.9	5.4	5.8	5.8
2.5 ≤ E < 2.7	4.8	4.9	5.7	5.8	5.3	5.7	5.7
2.7 ≤ E < 2.9	4.8	4.9	5.6	5.8	5.3	5.7	5.7
2.9 ≤ E < 3.1	4.7	4.8	5.5	5.7	5.2	5.6	5.6
3.1 ≤ E < 3.3	4.6	4.7	5.4	5.6	5.1	5.5	5.5
3.3 ≤ E < 3.5	4.6	4.7	5.4	5.6	5.0	5.5	5.5
3.5 ≤ E < 3.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
3.7 ≤ E < 3.9	4.5	4.6	5.3	5.4	5.0	5.4	5.4
3.9 ≤ E < 4.1	4.5	4.6	5.2	5.4	4.9	5.3	5.3
4.1 ≤ E < 4.3	4.4	4.5	5.2	5.4	4.9	5.3	5.3
4.3 ≤ E < 4.5	4.4	4.5	5.1	5.3	4.9	5.2	5.2
4.5 ≤ E < 4.7	4.4	4.5	5.1	5.3	4.8	5.2	5.2
4.7 ≤ E < 4.9	4.3	4.4	5.0	5.2	4.8	5.2	5.2
E ≥ 4.9	4.3	4.4	5.0	5.2	4.8	5.1	5.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.3	5.4	6.2	6.5	5.9	6.3	6.3
2.7 ≤ E < 2.9	5.2	5.3	6.1	6.4	5.8	6.2	6.2
2.9 ≤ E < 3.1	5.1	5.3	6.0	6.3	5.7	6.1	6.1
3.1 ≤ E < 3.3	5.0	5.2	6.0	6.2	5.6	6.0	6.0
3.3 ≤ E < 3.5	5.0	5.1	5.9	6.1	5.6	6.0	6.0
3.5 ≤ E < 3.7	4.9	5.0	5.9	6.0	5.5	5.9	5.9
3.7 ≤ E < 3.9	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.9 ≤ E < 4.1	4.8	5.0	5.7	5.9	5.4	5.8	5.8
4.1 ≤ E < 4.3	4.8	4.9	5.7	5.9	5.4	5.8	5.8
4.3 ≤ E < 4.5	4.8	4.9	5.7	5.8	5.3	5.8	5.7
4.5 ≤ E < 4.7	4.7	4.8	5.6	5.8	5.3	5.7	5.7
4.7 ≤ E < 4.9	4.7	4.8	5.6	5.8	5.2	5.7	5.7
E ≥ 4.9	4.6	4.8	5.5	5.7	5.2	5.6	5.6

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.5	5.6	6.6	6.8	6.0	6.6	6.6
2.7 ≤ E < 2.9	5.4	5.6	6.4	6.7	6.0	6.5	6.5
2.9 ≤ E < 3.1	5.3	5.5	6.3	6.6	5.9	6.4	6.4
3.1 ≤ E < 3.3	5.3	5.4	6.2	6.5	5.8	6.3	6.3
3.3 ≤ E < 3.5	5.2	5.3	6.1	6.4	5.8	6.3	6.2
3.5 ≤ E < 3.7	5.1	5.3	6.1	6.3	5.7	6.2	6.2
3.7 ≤ E < 3.9	5.0	5.2	6.0	6.2	5.7	6.1	6.1
3.9 ≤ E < 4.1	5.0	5.1	5.9	6.2	5.6	6.0	6.0
4.1 ≤ E < 4.3	5.0	5.1	5.9	6.1	5.6	6.0	6.0
4.3 ≤ E < 4.5	4.9	5.0	5.9	6.0	5.5	5.9	5.9
4.5 ≤ E < 4.7	4.9	5.0	5.8	6.0	5.5	5.9	5.9
4.7 ≤ E < 4.9	4.8	5.0	5.8	6.0	5.4	5.9	5.9
E ≥ 4.9	4.8	4.9	5.7	5.9	5.4	5.8	5.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.7	5.9	6.9	7.1	6.4	6.9	6.9
2.7 ≤ E < 2.9	5.6	5.8	6.7	7.0	6.2	6.8	6.8
2.9 ≤ E < 3.1	5.6	5.7	6.6	6.9	6.1	6.7	6.7
3.1 ≤ E < 3.3	5.5	5.6	6.5	6.8	6.0	6.6	6.6
3.3 ≤ E < 3.5	5.4	5.5	6.4	6.7	6.0	6.6	6.5
3.5 ≤ E < 3.7	5.3	5.5	6.4	6.6	5.9	6.5	6.5
3.7 ≤ E < 3.9	5.3	5.4	6.3	6.6	5.9	6.4	6.4
3.9 ≤ E < 4.1	5.2	5.4	6.2	6.5	5.8	6.3	6.3
4.1 ≤ E < 4.3	5.1	5.3	6.1	6.4	5.8	6.3	6.2
4.3 ≤ E < 4.5	5.1	5.2	6.0	6.3	5.7	6.2	6.2
4.5 ≤ E < 4.7	5.0	5.2	6.0	6.3	5.7	6.1	6.1
4.7 ≤ E < 4.9	5.0	5.1	6.0	6.2	5.6	6.1	6.1
E ≥ 4.9	4.9	5.1	5.9	6.2	5.6	6.0	6.0

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly(continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.9	6.1	7.2	7.5	6.7	7.3	7.3
2.7 ≤ E < 2.9	5.8	6.0	7.0	7.4	6.5	7.1	7.1
2.9 ≤ E < 3.1	5.8	5.9	6.9	7.3	6.4	7.0	7.0
3.1 ≤ E < 3.3	5.7	5.8	6.8	7.1	6.3	6.9	6.9
3.3 ≤ E < 3.5	5.6	5.8	6.7	7.0	6.2	6.8	6.8
3.5 ≤ E < 3.7	5.5	5.7	6.7	6.9	6.1	6.8	6.7
3.7 ≤ E < 3.9	5.5	5.6	6.6	6.8	6.1	6.7	6.7
3.9 ≤ E < 4.1	5.4	5.6	6.5	6.8	6.0	6.6	6.6
4.1 ≤ E < 4.3	5.3	5.5	6.4	6.7	6.0	6.5	6.5
4.3 ≤ E < 4.5	5.3	5.5	6.4	6.6	5.9	6.5	6.5
4.5 ≤ E < 4.7	5.2	5.4	6.3	6.6	5.9	6.4	6.4
4.7 ≤ E < 4.9	5.2	5.3	6.2	6.5	5.8	6.4	6.4
E ≥ 4.9	5.1	5.3	6.2	6.5	5.8	6.3	6.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.2	6.4	7.6	8.0	6.9	7.7	7.7
2.7 ≤ E < 2.9	6.0	6.2	7.4	7.8	6.8	7.5	7.5
2.9 ≤ E < 3.1	6.0	6.1	7.3	7.7	6.7	7.4	7.4
3.1 ≤ E < 3.3	5.9	6.0	7.2	7.5	6.6	7.3	7.3
3.3 ≤ E < 3.5	5.8	6.0	7.0	7.4	6.5	7.1	7.1
3.5 ≤ E < 3.7	5.8	5.9	6.9	7.3	6.4	7.0	7.0
3.7 ≤ E < 3.9	5.7	5.8	6.9	7.2	6.3	7.0	7.0
3.9 ≤ E < 4.1	5.6	5.8	6.8	7.1	6.3	6.9	6.9
4.1 ≤ E < 4.3	5.5	5.7	6.7	7.0	6.2	6.8	6.8
4.3 ≤ E < 4.5	5.5	5.7	6.7	6.9	6.1	6.8	6.8
4.5 ≤ E < 4.7	5.4	5.6	6.6	6.9	6.0	6.7	6.7
4.7 ≤ E < 4.9	5.4	5.6	6.5	6.8	6.0	6.6	6.6
E ≥ 4.9	5.3	5.5	6.5	6.8	6.0	6.6	6.6

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.3	6.6	7.8	8.3	7.1	7.9	7.9
2.9 ≤ E < 3.1	6.2	6.4	7.7	8.1	7.0	7.8	7.8
3.1 ≤ E < 3.3	6.1	6.3	7.6	7.9	6.9	7.7	7.7
3.3 ≤ E < 3.5	6.0	6.2	7.4	7.8	6.8	7.5	7.5
3.5 ≤ E < 3.7	5.9	6.1	7.3	7.7	6.7	7.4	7.4
3.7 ≤ E < 3.9	5.9	6.0	7.2	7.6	6.6	7.3	7.3
3.9 ≤ E < 4.1	5.8	6.0	7.1	7.5	6.6	7.2	7.2
4.1 ≤ E < 4.3	5.7	5.9	7.0	7.4	6.5	7.1	7.1
4.3 ≤ E < 4.5	5.7	5.9	6.9	7.3	6.4	7.0	7.0
4.5 ≤ E < 4.7	5.6	5.8	6.9	7.2	6.3	7.0	7.0
4.7 ≤ E < 4.9	5.6	5.8	6.8	7.1	6.3	6.9	6.9
E ≥ 4.9	5.5	5.7	6.7	7.0	6.2	6.9	6.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.6	6.8	8.3	8.8	7.5	8.4	8.4
2.9 ≤ E < 3.1	6.5	6.7	8.1	8.6	7.4	8.2	8.2
3.1 ≤ E < 3.3	6.4	6.6	7.9	8.4	7.2	8.0	8.0
3.3 ≤ E < 3.5	6.3	6.5	7.8	8.3	7.1	7.9	7.9
3.5 ≤ E < 3.7	6.2	6.4	7.7	8.1	7.0	7.8	7.8
3.7 ≤ E < 3.9	6.1	6.3	7.6	8.0	6.9	7.7	7.7
3.9 ≤ E < 4.1	6.0	6.2	7.5	7.9	6.8	7.6	7.6
4.1 ≤ E < 4.3	5.9	6.1	7.4	7.8	6.8	7.5	7.5
4.3 ≤ E < 4.5	5.9	6.0	7.3	7.7	6.7	7.4	7.4
4.5 ≤ E < 4.7	5.8	6.0	7.2	7.6	6.6	7.3	7.3
4.7 ≤ E < 4.9	5.8	5.9	7.1	7.5	6.6	7.2	7.2
E ≥ 4.9	5.7	5.9	7.0	7.4	6.5	7.2	7.1

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.9	7.2	8.8	9.4	7.9	8.9	8.9
2.9 ≤ E < 3.1	6.8	7.0	8.6	9.1	7.8	8.7	8.7
3.1 ≤ E < 3.3	6.7	6.9	8.4	8.9	7.6	8.5	8.5
3.3 ≤ E < 3.5	6.6	6.8	8.3	8.8	7.5	8.4	8.4
3.5 ≤ E < 3.7	6.5	6.7	8.1	8.6	7.4	8.2	8.2
3.7 ≤ E < 3.9	6.4	6.6	8.0	8.5	7.2	8.1	8.1
3.9 ≤ E < 4.1	6.3	6.5	7.9	8.3	7.1	8.0	8.0
4.1 ≤ E < 4.3	6.2	6.4	7.7	8.2	7.0	7.9	7.9
4.3 ≤ E < 4.5	6.1	6.3	7.7	8.1	7.0	7.8	7.8
4.5 ≤ E < 4.7	6.0	6.3	7.6	8.0	6.9	7.7	7.7
4.7 ≤ E < 4.9	6.0	6.2	7.5	7.9	6.8	7.6	7.6
E ≥ 4.9	5.9	6.1	7.4	7.8	6.8	7.6	7.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.3	7.6	9.3	10.0	8.4	9.5	9.5
2.9 ≤ E < 3.1	7.1	7.4	9.1	9.8	8.2	9.2	9.2
3.1 ≤ E < 3.3	7.0	7.2	8.9	9.5	8.0	9.0	9.0
3.3 ≤ E < 3.5	6.8	7.1	8.7	9.3	7.9	8.9	8.8
3.5 ≤ E < 3.7	6.7	7.0	8.6	9.1	7.7	8.7	8.7
3.7 ≤ E < 3.9	6.6	6.9	8.4	9.0	7.6	8.6	8.6
3.9 ≤ E < 4.1	6.5	6.8	8.3	8.8	7.5	8.4	8.4
4.1 ≤ E < 4.3	6.5	6.7	8.1	8.7	7.4	8.3	8.3
4.3 ≤ E < 4.5	6.4	6.6	8.0	8.6	7.3	8.2	8.2
4.5 ≤ E < 4.7	6.3	6.5	7.9	8.5	7.2	8.1	8.1
4.7 ≤ E < 4.9	6.2	6.5	7.8	8.4	7.1	8.0	8.0
E ≥ 4.9	6.1	6.4	7.8	8.3	7.0	7.9	7.9

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.6	8.0	10.0	10.8	8.9	10.1	10.1
2.9 ≤ E < 3.1	7.5	7.8	9.7	10.4	8.7	9.9	9.8
3.1 ≤ E < 3.3	7.3	7.6	9.5	10.2	8.5	9.6	9.6
3.3 ≤ E < 3.5	7.1	7.5	9.3	9.9	8.3	9.4	9.4
3.5 ≤ E < 3.7	7.0	7.3	9.1	9.7	8.1	9.2	9.2
3.7 ≤ E < 3.9	6.9	7.2	8.9	9.6	8.0	9.0	9.0
3.9 ≤ E < 4.1	6.8	7.1	8.8	9.4	7.9	8.9	8.9
4.1 ≤ E < 4.3	6.7	7.0	8.6	9.2	7.8	8.8	8.8
4.3 ≤ E < 4.5	6.6	6.9	8.5	9.1	7.7	8.7	8.7
4.5 ≤ E < 4.7	6.6	6.8	8.4	8.9	7.6	8.6	8.5
4.7 ≤ E < 4.9	6.5	6.8	8.3	8.8	7.5	8.5	8.4
E ≥ 4.9	6.4	6.7	8.2	8.7	7.4	8.4	8.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.8	8.1	10.4	11.2	9.2	10.5	10.6
3.1 ≤ E < 3.3	7.7	7.9	10.1	11.0	8.9	10.3	10.3
3.3 ≤ E < 3.5	7.5	7.7	9.9	10.7	8.8	10.0	10.0
3.5 ≤ E < 3.7	7.4	7.6	9.7	10.4	8.6	9.8	9.8
3.7 ≤ E < 3.9	7.2	7.5	9.5	10.2	8.4	9.6	9.6
3.9 ≤ E < 4.1	7.1	7.3	9.3	10.0	8.3	9.5	9.4
4.1 ≤ E < 4.3	7.0	7.2	9.1	9.8	8.1	9.3	9.3
4.3 ≤ E < 4.5	6.9	7.1	9.0	9.7	8.0	9.2	9.1
4.5 ≤ E < 4.7	6.8	7.0	8.9	9.5	7.9	9.0	9.0
4.7 ≤ E < 4.9	6.7	7.0	8.8	9.4	7.8	8.9	8.9
E ≥ 4.9	6.7	6.9	8.7	9.3	7.8	8.8	8.8

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.1	8.5	11.2	12.0	9.7	11.3	11.3
3.1 ≤ E < 3.3	7.9	8.3	10.9	11.7	9.5	11.0	11.0
3.3 ≤ E < 3.5	7.8	8.1	10.6	11.4	9.3	10.8	10.7
3.5 ≤ E < 3.7	7.6	8.0	10.3	11.2	9.1	10.5	10.5
3.7 ≤ E < 3.9	7.5	7.8	10.1	10.9	8.9	10.3	10.2
3.9 ≤ E < 4.1	7.3	7.7	9.9	10.7	8.8	10.0	10.0
4.1 ≤ E < 4.3	7.2	7.6	9.7	10.5	8.6	9.9	9.9
4.3 ≤ E < 4.5	7.1	7.5	9.6	10.3	8.5	9.7	9.7
4.5 ≤ E < 4.7	7.0	7.4	9.4	10.1	8.4	9.6	9.6
4.7 ≤ E < 4.9	6.9	7.3	9.3	10.0	8.2	9.5	9.4
E ≥ 4.9	6.9	7.2	9.1	9.9	8.1	9.3	9.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.6	9.0	11.9	12.6	10.4	12.0	12.0
3.1 ≤ E < 3.3	8.3	8.8	11.6	12.2	10.1	11.8	11.7
3.3 ≤ E < 3.5	8.1	8.6	11.3	11.9	9.9	11.5	11.5
3.5 ≤ E < 3.7	8.0	8.4	11.1	11.6	9.7	11.3	11.2
3.7 ≤ E < 3.9	7.8	8.3	10.8	11.4	9.5	11.0	11.0
3.9 ≤ E < 4.1	7.7	8.1	10.6	11.2	9.3	10.8	10.8
4.1 ≤ E < 4.3	7.6	8.0	10.3	11.0	9.1	10.6	10.6
4.3 ≤ E < 4.5	7.5	7.9	10.1	10.8	9.0	10.4	10.4
4.5 ≤ E < 4.7	7.4	7.7	10.0	10.6	8.8	10.2	10.2
4.7 ≤ E < 4.9	7.2	7.6	9.8	10.4	8.7	10.0	10.0
E ≥ 4.9	7.1	7.5	9.7	10.3	8.6	9.9	9.9

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	9.0	9.6	12.4	13.5	11.1	12.9	12.9
3.1 ≤ E < 3.3	8.8	9.4	12.0	13.1	10.9	12.6	12.6
3.3 ≤ E < 3.5	8.6	9.1	11.8	12.8	10.6	12.3	12.2
3.5 ≤ E < 3.7	8.4	8.9	11.5	12.5	10.3	12.0	11.9
3.7 ≤ E < 3.9	8.2	8.8	11.2	12.2	10.0	11.7	11.7
3.9 ≤ E < 4.1	8.0	8.6	11.0	11.9	9.8	11.5	11.5
4.1 ≤ E < 4.3	7.9	8.4	10.8	11.7	9.6	11.3	11.3
4.3 ≤ E < 4.5	7.8	8.2	10.6	11.5	9.5	11.1	11.1
4.5 ≤ E < 4.7	7.7	8.1	10.4	11.3	9.3	10.9	10.9
4.7 ≤ E < 4.9	7.6	8.0	10.2	11.2	9.2	10.7	10.7
E ≥ 4.9	7.5	7.9	10.0	11.0	9.0	10.6	10.6
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	9.6	10.2	13.3	14.4	11.8	13.8	13.8
3.1 ≤ E < 3.3	9.3	9.9	12.9	14.0	11.5	13.5	13.4
3.3 ≤ E < 3.5	9.1	9.7	12.5	13.7	11.3	13.2	13.1
3.5 ≤ E < 3.7	8.9	9.4	12.2	13.3	11.0	12.8	12.8
3.7 ≤ E < 3.9	8.7	9.2	11.9	13.0	10.7	12.5	12.5
3.9 ≤ E < 4.1	8.5	9.0	11.7	12.8	10.5	12.2	12.2
4.1 ≤ E < 4.3	8.3	8.9	11.5	12.5	10.3	12.0	12.0
4.3 ≤ E < 4.5	8.2	8.7	11.3	12.2	10.0	11.8	11.8
4.5 ≤ E < 4.7	8.0	8.6	11.1	12.0	9.9	11.6	11.6
4.7 ≤ E < 4.9	7.9	8.4	10.9	11.9	9.7	11.5	11.4
E ≥ 4.9	7.8	8.6	10.8	11.7	9.6	11.3	11.3

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly(continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	9.9	10.6	13.7	15.0	12.3	14.4	14.4
3.3 ≤ E < 3.5	9.6	10.3	13.4	14.6	11.9	14.0	14.0
3.5 ≤ E < 3.7	9.4	10.0	13.1	14.2	11.7	13.7	13.7
3.7 ≤ E < 3.9	9.2	9.8	12.8	13.9	11.5	13.4	13.4
3.9 ≤ E < 4.1	9.0	9.6	12.5	13.6	11.2	13.1	13.1
4.1 ≤ E < 4.3	8.8	9.4	12.2	13.4	11.0	12.9	12.8
4.3 ≤ E < 4.5	8.7	9.2	12.0	13.1	10.8	12.6	12.6
4.5 ≤ E < 4.7	8.5	9.1	11.8	12.9	10.6	12.4	12.3
4.7 ≤ E < 4.9	8.4	8.9	11.6	12.7	10.3	12.2	12.1
E ≥ 4.9	8.3	8.8	11.4	12.5	10.2	12.0	11.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	10.6	11.3	14.7	16.0	12.8	15.3	15.4
3.3 ≤ E < 3.5	10.2	11.0	14.3	15.6	12.4	15.0	14.9
3.5 ≤ E < 3.7	9.9	10.7	13.9	15.2	12.1	14.6	14.6
3.7 ≤ E < 3.9	9.7	10.4	13.6	14.9	11.8	14.3	14.2
3.9 ≤ E < 4.1	9.5	10.2	13.3	14.6	11.6	14.0	13.9
4.1 ≤ E < 4.3	9.3	9.9	13.0	14.3	11.4	13.7	13.7
4.3 ≤ E < 4.5	9.1	9.8	12.8	14.0	11.1	13.5	13.4
4.5 ≤ E < 4.7	8.9	9.6	12.5	13.8	10.9	13.2	13.2
4.7 ≤ E < 4.9	8.8	9.4	12.3	13.6	10.7	13.0	13.0
E ≥ 4.9	8.7	9.3	12.1	13.4	10.6	12.8	12.8

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	11.2	12.0	15.6	17.0	13.6	16.3	16.3
3.3 ≤ E < 3.5	10.9	11.7	15.2	16.6	13.3	16.0	15.9
3.5 ≤ E < 3.7	10.6	11.4	14.9	16.2	12.9	15.6	15.5
3.7 ≤ E < 3.9	10.3	11.1	14.5	15.9	12.6	15.2	15.2
3.9 ≤ E < 4.1	10.0	10.9	14.2	15.5	12.2	14.9	14.9
4.1 ≤ E < 4.3	9.8	10.6	13.8	15.2	12.0	14.6	14.6
4.3 ≤ E < 4.5	9.6	10.4	13.6	14.9	11.8	14.4	14.3
4.5 ≤ E < 4.7	9.4	10.2	13.4	14.7	11.6	14.1	14.0
4.7 ≤ E < 4.9	9.3	10.0	13.2	14.4	11.4	13.8	13.8
E ≥ 4.9	9.1	9.8	12.9	14.2	11.2	13.6	13.6
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	11.9	12.8	16.6	18.0	14.5	17.3	17.3
3.3 ≤ E < 3.5	11.6	12.4	16.2	17.6	14.0	16.9	16.9
3.5 ≤ E < 3.7	11.3	12.0	15.8	17.2	13.7	16.6	16.5
3.7 ≤ E < 3.9	11.0	11.8	15.5	16.8	13.4	16.2	16.2
3.9 ≤ E < 4.1	10.7	11.5	15.1	16.5	13.1	15.9	15.8
4.1 ≤ E < 4.3	10.4	11.3	14.8	16.2	12.8	15.6	15.5
4.3 ≤ E < 4.5	10.2	11.1	14.5	15.9	12.5	15.3	15.2
4.5 ≤ E < 4.7	10.0	10.9	14.2	15.6	12.3	15.0	15.0
4.7 ≤ E < 4.9	9.8	10.6	14.0	15.4	12.0	14.8	14.7
E ≥ 4.9	9.6	10.4	13.8	15.1	11.9	14.5	14.5

Table 5.8.9-4 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	12.6	13.6	17.6	19.0	15.4	18.3	18.3
3.3 ≤ E < 3.5	12.2	13.2	17.2	18.6	15.0	17.9	17.9
3.5 ≤ E < 3.7	11.9	12.9	16.8	18.2	14.6	17.6	17.5
3.7 ≤ E < 3.9	11.6	12.6	16.4	17.8	14.2	17.2	17.2
3.9 ≤ E < 4.1	11.3	12.2	16.0	17.5	13.9	16.9	16.8
4.1 ≤ E < 4.3	11.1	12.0	15.7	17.2	13.6	16.5	16.5
4.3 ≤ E < 4.5	10.8	11.7	15.4	16.9	13.3	16.2	16.2
4.5 ≤ E < 4.7	10.6	11.5	15.2	16.6	13.1	15.9	15.9
4.7 ≤ E < 4.9	10.4	11.3	14.9	16.3	12.8	15.7	15.6
E ≥ 4.9	10.2	11.1	14.6	16.1	12.6	15.4	15.4
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	13.0	14.0	18.1	19.6	15.9	18.5	18.5
3.5 ≤ E < 3.7	12.6	13.7	17.7	19.2	15.5	18.1	18.0
3.7 ≤ E < 3.9	12.3	13.4	17.4	18.9	15.1	17.7	17.7
3.9 ≤ E < 4.1	12.0	13.1	17.0	18.5	14.8	17.4	17.3
4.1 ≤ E < 4.3	11.7	12.7	16.6	18.1	14.4	17.0	17.0
4.3 ≤ E < 4.5	11.5	12.4	16.3	17.9	14.1	16.7	16.7
4.5 ≤ E < 4.7	11.2	12.2	16.0	17.5	13.9	16.4	16.4
4.7 ≤ E < 4.9	11.0	11.9	15.8	17.3	13.6	16.1	16.1
E ≥ 4.9	10.8	11.8	15.5	17.1	13.4	15.9	15.8

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.8	4.9	5.6	5.7	5.2	5.6	5.6
2.3 ≤ E < 2.5	4.7	4.8	5.5	5.7	5.2	5.6	5.6
2.5 ≤ E < 2.7	4.7	4.8	5.4	5.6	5.1	5.5	5.5
2.7 ≤ E < 2.9	4.6	4.7	5.4	5.5	5.0	5.5	5.5
2.9 ≤ E < 3.1	4.6	4.7	5.3	5.5	5.0	5.4	5.4
3.1 ≤ E < 3.3	4.5	4.6	5.3	5.4	5.0	5.3	5.3
3.3 ≤ E < 3.5	4.5	4.6	5.2	5.4	4.9	5.3	5.3
3.5 ≤ E < 3.7	4.5	4.5	5.1	5.3	4.9	5.2	5.2
3.7 ≤ E < 3.9	4.4	4.5	5.1	5.3	4.8	5.2	5.2
3.9 ≤ E < 4.1	4.4	4.5	5.0	5.2	4.8	5.2	5.1
4.1 ≤ E < 4.3	4.4	4.4	5.0	5.2	4.8	5.1	5.1
4.3 ≤ E < 4.5	4.3	4.4	5.0	5.1	4.8	5.1	5.1
4.5 ≤ E < 4.7	4.3	4.4	5.0	5.1	4.7	5.0	5.0
4.7 ≤ E < 4.9	4.3	4.4	4.9	5.1	4.7	5.0	5.0
E ≥ 4.9	4.3	4.3	4.9	5.0	4.7	5.0	5.0
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	5.2	5.3	6.0	6.3	5.7	6.1	6.1
2.5 ≤ E < 2.7	5.1	5.2	6.0	6.2	5.7	6.0	6.0
2.7 ≤ E < 2.9	5.0	5.2	5.9	6.1	5.6	6.0	6.0
2.9 ≤ E < 3.1	5.0	5.1	5.9	6.0	5.5	5.9	5.9
3.1 ≤ E < 3.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.3 ≤ E < 3.5	4.9	5.0	5.8	5.9	5.4	5.8	5.8
3.5 ≤ E < 3.7	4.9	4.9	5.7	5.9	5.4	5.8	5.8
3.7 ≤ E < 3.9	4.8	4.9	5.7	5.8	5.3	5.8	5.8
3.9 ≤ E < 4.1	4.8	4.9	5.6	5.8	5.3	5.7	5.7
4.1 ≤ E < 4.3	4.7	4.8	5.6	5.8	5.2	5.7	5.7
4.3 ≤ E < 4.5	4.7	4.8	5.5	5.7	5.2	5.6	5.6
4.5 ≤ E < 4.7	4.7	4.8	5.5	5.7	5.2	5.6	5.6
4.7 ≤ E < 4.9	4.6	4.7	5.5	5.7	5.1	5.6	5.6
E ≥ 4.9	4.6	4.7	5.4	5.6	5.1	5.5	5.5

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	5.8	5.9	6.9	7.1	6.4	6.9	6.9
2.5 ≤ E < 2.7	5.7	5.8	6.8	7.0	6.3	6.8	6.8
2.7 ≤ E < 2.9	5.6	5.7	6.7	6.9	6.2	6.7	6.7
2.9 ≤ E < 3.1	5.5	5.7	6.6	6.8	6.1	6.7	6.7
3.1 ≤ E < 3.3	5.5	5.6	6.5	6.8	6.0	6.6	6.6
3.3 ≤ E < 3.5	5.4	5.5	6.4	6.7	6.0	6.5	6.5
3.5 ≤ E < 3.7	5.3	5.5	6.3	6.6	5.9	6.5	6.4
3.7 ≤ E < 3.9	5.3	5.4	6.3	6.5	5.9	6.4	6.4
3.9 ≤ E < 4.1	5.2	5.4	6.2	6.5	5.8	6.3	6.3
4.1 ≤ E < 4.3	5.2	5.3	6.1	6.4	5.8	6.3	6.3
4.3 ≤ E < 4.5	5.1	5.3	6.1	6.4	5.7	6.2	6.2
4.5 ≤ E < 4.7	5.1	5.2	6.0	6.3	5.7	6.2	6.2
4.7 ≤ E < 4.9	5.0	5.2	6.0	6.3	5.7	6.1	6.1
E ≥ 4.9	5.0	5.1	6.0	6.2	5.6	6.1	6.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.3	6.5	7.7	8.1	7.0	7.8	7.8
2.7 ≤ E < 2.9	6.2	6.4	7.6	8.0	6.9	7.7	7.7
2.9 ≤ E < 3.1	6.1	6.3	7.5	7.8	6.9	7.6	7.6
3.1 ≤ E < 3.3	6.0	6.2	7.4	7.7	6.8	7.4	7.4
3.3 ≤ E < 3.5	5.9	6.1	7.2	7.6	6.7	7.3	7.3
3.5 ≤ E < 3.7	5.9	6.0	7.1	7.5	6.6	7.3	7.2
3.7 ≤ E < 3.9	5.8	6.0	7.1	7.4	6.5	7.2	7.1
3.9 ≤ E < 4.1	5.8	5.9	7.0	7.4	6.5	7.1	7.1
4.1 ≤ E < 4.3	5.7	5.9	6.9	7.3	6.4	7.0	7.0
4.3 ≤ E < 4.5	5.7	5.8	6.9	7.2	6.4	7.0	7.0
4.5 ≤ E < 4.7	5.6	5.8	6.8	7.1	6.3	6.9	6.9
4.7 ≤ E < 4.9	5.6	5.7	6.8	7.1	6.3	6.9	6.9
E ≥ 4.9	5.5	5.7	6.7	7.0	6.2	6.8	6.8

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % 235U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.6	6.8	8.2	8.7	7.4	8.3	8.3
2.7 ≤ E < 2.9	6.5	6.7	8.0	8.5	7.3	8.1	8.1
2.9 ≤ E < 3.1	6.4	6.6	7.9	8.3	7.2	8.0	8.0
3.1 ≤ E < 3.3	6.3	6.5	7.8	8.2	7.1	7.9	7.9
3.3 ≤ E < 3.5	6.2	6.4	7.7	8.0	7.0	7.8	7.8
3.5 ≤ E < 3.7	6.1	6.3	7.6	8.0	6.9	7.7	7.7
3.7 ≤ E < 3.9	6.0	6.2	7.5	7.9	6.8	7.6	7.6
3.9 ≤ E < 4.1	6.0	6.1	7.4	7.8	6.8	7.5	7.5
4.1 ≤ E < 4.3	5.9	6.1	7.3	7.7	6.7	7.4	7.4
4.3 ≤ E < 4.5	5.9	6.0	7.2	7.6	6.7	7.4	7.3
4.5 ≤ E < 4.7	5.8	6.0	7.1	7.6	6.6	7.3	7.3
4.7 ≤ E < 4.9	5.8	5.9	7.1	7.5	6.6	7.2	7.2
E ≥ 4.9	5.7	5.9	7.0	7.4	6.5	7.2	7.2
Minimum Initial Assembly Avg. Enrichment wt % 235U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.9	7.1	8.7	9.3	7.8	8.8	8.8
2.7 ≤ E < 2.9	6.8	7.0	8.6	9.0	7.7	8.6	8.6
2.9 ≤ E < 3.1	6.7	6.9	8.4	8.9	7.6	8.5	8.5
3.1 ≤ E < 3.3	6.6	6.8	8.2	8.7	7.5	8.3	8.3
3.3 ≤ E < 3.5	6.5	6.7	8.1	8.6	7.3	8.2	8.2
3.5 ≤ E < 3.7	6.4	6.6	8.0	8.5	7.2	8.1	8.1
3.7 ≤ E < 3.9	6.3	6.5	7.9	8.3	7.1	8.0	8.0
3.9 ≤ E < 4.1	6.2	6.5	7.8	8.2	7.1	7.9	7.9
4.1 ≤ E < 4.3	6.1	6.4	7.7	8.1	7.0	7.8	7.8
4.3 ≤ E < 4.5	6.1	6.3	7.6	8.0	6.9	7.8	7.7
4.5 ≤ E < 4.7	6.0	6.3	7.6	8.0	6.9	7.7	7.7
4.7 ≤ E < 4.9	6.0	6.2	7.5	7.9	6.8	7.6	7.6
E ≥ 4.9	5.9	6.1	7.4	7.8	6.8	7.6	7.6

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	7.3	7.5	9.3	9.9	8.3	9.4	9.4
2.7 ≤ E < 2.9	7.1	7.4	9.1	9.7	8.1	9.2	9.2
2.9 ≤ E < 3.1	7.0	7.2	8.9	9.5	8.0	9.0	9.0
3.1 ≤ E < 3.3	6.9	7.1	8.8	9.3	7.9	8.9	8.8
3.3 ≤ E < 3.5	6.8	7.0	8.6	9.2	7.8	8.7	8.7
3.5 ≤ E < 3.7	6.7	6.9	8.5	9.0	7.7	8.6	8.6
3.7 ≤ E < 3.9	6.6	6.8	8.4	8.9	7.6	8.5	8.5
3.9 ≤ E < 4.1	6.5	6.8	8.2	8.8	7.5	8.4	8.4
4.1 ≤ E < 4.3	6.5	6.7	8.1	8.7	7.4	8.3	8.3
4.3 ≤ E < 4.5	6.4	6.6	8.0	8.6	7.3	8.2	8.2
4.5 ≤ E < 4.7	6.3	6.6	8.0	8.5	7.2	8.1	8.1
4.7 ≤ E < 4.9	6.2	6.5	7.9	8.4	7.2	8.0	8.0
E ≥ 4.9	6.2	6.4	7.8	8.3	7.1	8.0	8.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	7.7	8.0	10.0	10.8	8.8	10.0	10.1
2.7 ≤ E < 2.9	7.5	7.8	9.7	10.5	8.7	9.9	9.8
2.9 ≤ E < 3.1	7.4	7.7	9.5	10.2	8.5	9.7	9.6
3.1 ≤ E < 3.3	7.2	7.5	9.3	10.0	8.3	9.5	9.4
3.3 ≤ E < 3.5	7.1	7.4	9.2	9.8	8.2	9.3	9.3
3.5 ≤ E < 3.7	7.1	7.3	9.0	9.7	8.0	9.1	9.1
3.7 ≤ E < 3.9	6.9	7.2	8.9	9.5	8.0	9.0	9.0
3.9 ≤ E < 4.1	6.8	7.1	8.8	9.4	7.9	8.9	8.9
4.1 ≤ E < 4.3	6.7	7.0	8.7	9.2	7.8	8.8	8.8
4.3 ≤ E < 4.5	6.7	6.9	8.5	9.1	7.7	8.7	8.7
4.5 ≤ E < 4.7	6.6	6.9	8.5	9.0	7.6	8.6	8.6
4.7 ≤ E < 4.9	6.6	6.8	8.4	8.9	7.6	8.5	8.5
E ≥ 4.9	6.5	6.8	8.3	8.9	7.5	8.5	8.4

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.9	8.2	10.5	11.4	9.2	10.6	10.6
2.9 ≤ E < 3.1	7.8	8.1	10.2	11.1	9.0	10.4	10.4
3.1 ≤ E < 3.3	7.6	7.9	10.0	10.8	8.8	10.1	10.1
3.3 ≤ E < 3.5	7.5	7.8	9.8	10.6	8.7	9.9	9.9
3.5 ≤ E < 3.7	7.3	7.7	9.6	10.4	8.6	9.8	9.8
3.7 ≤ E < 3.9	7.2	7.6	9.5	10.2	8.4	9.6	9.6
3.9 ≤ E < 4.1	7.1	7.5	9.3	10.0	8.3	9.5	9.5
4.1 ≤ E < 4.3	7.0	7.4	9.2	9.9	8.2	9.4	9.3
4.3 ≤ E < 4.5	7.0	7.3	9.1	9.8	8.1	9.2	9.2
4.5 ≤ E < 4.7	6.9	7.2	9.0	9.7	8.0	9.1	9.1
4.7 ≤ E < 4.9	6.8	7.1	8.9	9.6	7.9	9.0	9.0
E ≥ 4.9	6.8	7.0	8.8	9.5	7.9	9.0	8.9
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.4	8.8	11.3	12.1	9.8	11.4	11.4
2.9 ≤ E < 3.1	8.2	8.6	11.0	11.9	9.6	11.2	11.2
3.1 ≤ E < 3.3	8.0	8.4	10.8	11.6	9.4	10.9	10.9
3.3 ≤ E < 3.5	7.9	8.2	10.6	11.4	9.2	10.7	10.7
3.5 ≤ E < 3.7	7.7	8.1	10.3	11.2	9.0	10.5	10.5
3.7 ≤ E < 3.9	7.6	8.0	10.1	11.0	8.9	10.3	10.3
3.9 ≤ E < 4.1	7.5	7.9	10.0	10.8	8.8	10.1	10.1
4.1 ≤ E < 4.3	7.4	7.8	9.8	10.7	8.7	10.0	9.9
4.3 ≤ E < 4.5	7.3	7.7	9.7	10.5	8.6	9.9	9.9
4.5 ≤ E < 4.7	7.2	7.6	9.6	10.4	8.5	9.8	9.7
4.7 ≤ E < 4.9	7.1	7.5	9.5	10.2	8.4	9.7	9.6
E ≥ 4.9	7.1	7.4	9.4	10.1	8.3	9.6	9.5

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.9	9.4	12.1	13.2	10.6	12.3	12.3
2.9 ≤ E < 3.1	8.7	9.1	11.8	12.8	10.3	12.0	12.0
3.1 ≤ E < 3.3	8.5	8.9	11.6	12.6	10.0	11.7	11.7
3.3 ≤ E < 3.5	8.3	8.8	11.3	12.2	9.8	11.5	11.5
3.5 ≤ E < 3.7	8.2	8.6	11.1	12.0	9.7	11.3	11.3
3.7 ≤ E < 3.9	8.0	8.5	10.9	11.8	9.5	11.1	11.1
3.9 ≤ E < 4.1	7.9	8.3	10.8	11.6	9.4	10.9	10.9
4.1 ≤ E < 4.3	7.8	8.2	10.6	11.5	9.2	10.8	10.7
4.3 ≤ E < 4.5	7.7	8.1	10.4	11.3	9.1	10.6	10.6
4.5 ≤ E < 4.7	7.6	8.0	10.2	11.2	9.0	10.5	10.4
4.7 ≤ E < 4.9	7.5	7.9	10.1	11.0	8.9	10.3	10.3
E ≥ 4.9	7.4	7.8	10.0	10.9	8.8	10.2	10.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	9.5	10.0	13.1	14.2	11.4	13.3	13.2
2.9 ≤ E < 3.1	9.2	9.8	12.7	13.8	11.1	12.9	12.9
3.1 ≤ E < 3.3	9.0	9.5	12.4	13.5	10.8	12.6	12.6
3.3 ≤ E < 3.5	8.8	9.3	12.1	13.2	10.6	12.4	12.3
3.5 ≤ E < 3.7	8.6	9.1	11.9	13.0	10.4	12.0	12.1
3.7 ≤ E < 3.9	8.5	9.0	11.7	12.7	10.1	11.9	11.9
3.9 ≤ E < 4.1	8.3	8.8	11.5	12.5	10.0	11.7	11.7
4.1 ≤ E < 4.3	8.2	8.7	11.3	12.3	9.8	11.5	11.5
4.3 ≤ E < 4.5	8.1	8.6	11.2	12.1	9.7	11.4	11.4
4.5 ≤ E < 4.7	8.0	8.5	11.0	11.9	9.6	11.3	11.2
4.7 ≤ E < 4.9	7.[illegible]	8.3	10.9	11.8	9.5	11.1	11.1
E ≥ 4.9	7.8	8.2	10.7	11.7	9.4	11.0	11.0

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	10.1	10.8	14.0	15.3	12.1	14.2	14.2
2.9 ≤ E < 3.1	9.8	10.5	13.7	14.9	11.9	13.9	13.9
3.1 ≤ E < 3.3	9.6	10.2	13.4	14.6	11.6	13.6	13.5
3.3 ≤ E < 3.5	9.4	9.9	13.1	14.2	11.4	13.3	13.3
3.5 ≤ E < 3.7	9.1	9.7	12.8	13.9	11.2	13.1	13.0
3.7 ≤ E < 3.9	9.0	9.6	12.5	13.7	10.9	12.8	12.8
3.9 ≤ E < 4.1	8.8	9.4	12.3	13.5	10.7	12.6	12.5
4.1 ≤ E < 4.3	8.7	9.2	12.1	13.2	10.5	12.3	12.3
4.3 ≤ E < 4.5	8.6	9.1	11.9	13.0	10.4	12.1	12.1
4.5 ≤ E < 4.7	8.5	8.9	11.8	12.9	10.2	12.0	12.0
4.7 ≤ E < 4.9	8.4	8.8	11.6	12.7	10.0	11.8	11.8
E ≥ 4.9	8.2	8.7	11.5	12.5	9.9	11.7	11.7
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	10.5	11.0	14.7	16.0	12.8	14.9	14.9
3.1 ≤ E < 3.3	10.2	10.7	14.4	15.6	12.4	14.6	14.6
3.3 ≤ E < 3.5	10.0	10.5	14.0	15.3	12.1	14.3	14.2
3.5 ≤ E < 3.7	9.8	10.2	13.7	15.0	11.9	14.0	14.0
3.7 ≤ E < 3.9	9.6	10.0	13.5	14.7	11.6	13.7	13.7
3.9 ≤ E < 4.1	9.4	9.8	13.2	14.4	11.5	13.5	13.5
4.1 ≤ E < 4.3	9.2	9.6	13.0	14.2	11.3	13.3	13.2
4.3 ≤ E < 4.5	9.1	9.5	12.8	14.0	11.1	13.1	13.1
4.5 ≤ E < 4.7	8.9	9.3	12.6	13.8	11.0	12.9	12.9
4.7 ≤ E < 4.9	8.8	9.2	12.4	13.7	10.8	12.7	12.7
E ≥ 4.9	8.7	9.1	12.3	13.5	10.7	12.6	12.5

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.0	11.8	15.8	17.2	13.7	16.0	16.0
3.1 ≤ E < 3.3	10.7	11.5	15.4	16.8	13.4	15.7	15.6
3.3 ≤ E < 3.5	10.4	11.2	15.1	16.4	13.1	15.3	15.3
3.5 ≤ E < 3.7	10.1	10.9	14.8	16.1	12.8	15.0	15.0
3.7 ≤ E < 3.9	9.9	10.7	14.4	15.8	12.5	14.8	14.7
3.9 ≤ E < 4.1	9.7	10.5	14.2	15.5	12.2	14.5	14.4
4.1 ≤ E < 4.3	9.6	10.3	13.9	15.3	12.0	14.2	14.2
4.3 ≤ E < 4.5	9.4	10.1	13.7	15.1	11.8	14.0	13.9
4.5 ≤ E < 4.7	9.3	9.9	13.5	14.9	11.7	13.8	13.8
4.7 ≤ E < 4.9	9.1	9.8	13.4	14.6	11.5	13.6	13.6
E ≥ 4.9	9.0	9.7	13.2	14.4	11.4	13.4	13.5
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.7	12.6	16.9	17.9	14.7	17.2	17.1
3.1 ≤ E < 3.3	11.4	12.3	16.5	17.5	14.3	16.8	16.7
3.3 ≤ E < 3.5	11.1	11.9	16.1	17.1	14.0	16.4	16.4
3.5 ≤ E < 3.7	10.9	11.7	15.8	16.8	13.7	16.1	16.1
3.7 ≤ E < 3.9	10.6	11.5	15.5	16.5	13.4	15.8	15.8
3.9 ≤ E < 4.1	10.4	11.2	15.2	16.2	13.2	15.5	15.5
4.1 ≤ E < 4.3	10.2	11.0	15.0	15.9	12.9	15.3	15.2
4.3 ≤ E < 4.5	10.0	10.8	14.7	15.7	12.7	15.1	15.0
4.5 ≤ E < 4.7	9.8	10.6	14.5	15.5	12.5	14.8	14.8
4.7 ≤ E < 4.9	9.7	10.5	14.3	15.3	12.3	14.6	14.6
E ≥ 4.9	9.6	10.3	14.0	15.1	12.1	14.4	14.4

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	12.5	13.5	17.6	19.0	15.7	18.3	18.2
3.1 ≤ E < 3.3	12.1	13.1	17.2	18.6	15.3	17.9	17.8
3.3 ≤ E < 3.5	11.9	12.8	16.8	18.2	15.0	17.5	17.5
3.5 ≤ E < 3.7	11.6	12.5	16.4	17.9	14.6	17.2	17.2
3.7 ≤ E < 3.9	11.3	12.4	16.1	17.6	14.4	16.9	16.8
3.9 ≤ E < 4.1	11.1	12.0	15.8	17.3	14.0	16.6	16.6
4.1 ≤ E < 4.3	10.9	11.7	15.6	17.0	13.8	16.3	16.3
4.3 ≤ E < 4.5	10.7	11.5	15.3	16.8	13.6	16.1	16.0
4.5 ≤ E < 4.7	10.5	11.3	15.1	16.5	13.4	15.9	15.8
4.7 ≤ E < 4.9	10.3	11.2	14.9	16.3	13.2	15.6	15.6
E ≥ 4.9	10.2	11.0	14.7	16.1	13.0	15.4	15.4

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	13.4	14.5	18.6	20.1	16.8	19.4	19.3
3.1 ≤ E < 3.3	13.0	14.0	18.2	19.7	16.4	19.0	19.0
3.3 ≤ E < 3.5	12.6	13.7	17.8	19.4	16.0	18.7	18.6
3.5 ≤ E < 3.7	12.3	13.4	17.5	19.1	15.7	18.3	18.3
3.7 ≤ E < 3.9	12.0	13.1	17.2	18.7	15.3	18.0	17.9
3.9 ≤ E < 4.1	11.8	12.8	16.9	18.4	15.1	17.7	17.7
4.1 ≤ E < 4.3	11.6	12.5	16.6	18.1	14.8	17.4	17.4
4.3 ≤ E < 4.5	11.3	12.3	16.3	17.9	14.5	17.2	17.1
4.5 ≤ E < 4.7	11.2	12.0	16.1	17.6	14.3	16.9	16.9
4.7 ≤ E < 4.9	11.0	11.9	15.9	17.4	14.0	16.7	16.6
E ≥ 4.9	10.8	12.1	15.7	17.2	13.9	16.4	16.4

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	13.9	15.1	19.3	20.9	17.4	20.1	20.1
3.3 ≤ E < 3.5	13.5	14.7	18.9	20.5	17.1	19.8	19.7
3.5 ≤ E < 3.7	13.2	14.3	18.6	20.1	16.7	19.4	19.4
3.7 ≤ E < 3.9	12.9	14.0	18.2	19.8	16.4	19.2	19.1
3.9 ≤ E < 4.1	12.6	13.7	17.9	19.5	16.0	18.8	18.7
4.1 ≤ E < 4.3	12.3	13.4	17.6	19.2	15.7	18.5	18.5
4.3 ≤ E < 4.5	12.1	13.2	17.3	19.0	15.5	18.3	18.2
4.5 ≤ E < 4.7	11.9	13.0	17.1	18.7	15.2	18.0	18.0
4.7 ≤ E < 4.9	11.7	12.8	16.9	18.5	15.0	17.8	17.7
E ≥ 4.9	11.5	12.5	16.7	18.3	14.8	17.6	17.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	14.8	16.0	20.4	22.1	18.0	21.3	21.2
3.3 ≤ E < 3.5	14.4	15.6	20.0	21.7	17.6	20.9	20.9
3.5 ≤ E < 3.7	14.0	15.3	19.6	21.4	17.2	20.5	20.5
3.7 ≤ E < 3.9	13.7	14.9	19.3	21.0	16.9	20.3	20.2
3.9 ≤ E < 4.1	13.4	14.7	19.0	20.7	16.6	19.9	19.8
4.1 ≤ E < 4.3	13.2	14.3	18.7	20.4	16.3	19.6	19.6
4.3 ≤ E < 4.5	12.9	14.1	18.4	20.1	16.0	19.4	19.4
4.5 ≤ E < 4.7	12.7	13.8	18.1	19.9	15.7	19.1	19.1
4.7 ≤ E < 4.9	12.5	13.6	17.9	19.6	15.5	18.9	18.8
E ≥ 4.9	12.2	13.4	17.7	19.4	15.4	18.7	18.6

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	15.7	17.0	21.5	23.2	19.1	22.4	22.3
3.3 ≤ E < 3.5	15.3	16.6	21.1	22.8	18.7	22.0	21.9
3.5 ≤ E < 3.7	15.0	16.3	20.7	22.4	18.3	21.7	21.7
3.7 ≤ E < 3.9	14.6	15.9	20.4	22.1	17.9	21.4	21.3
3.9 ≤ E < 4.1	14.2	15.6	20.1	21.8	17.6	21.0	21.0
4.1 ≤ E < 4.3	14.0	15.3	19.7	21.5	17.3	20.7	20.7
4.3 ≤ E < 4.5	13.7	15.0	19.5	21.2	17.0	20.4	20.4
4.5 ≤ E < 4.7	13.5	14.7	19.2	21.0	16.7	20.2	20.2
4.7 ≤ E < 4.9	13.3	14.5	19.0	20.7	16.5	20.0	19.9
E ≥ 4.9	13.1	14.2	18.7	20.5	16.3	19.8	19.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	16.7	18.1	22.6	24.2	20.1	23.5	23.4
3.3 ≤ E < 3.5	16.3	17.6	22.2	23.9	19.7	23.1	23.1
3.5 ≤ E < 3.7	15.9	17.3	21.8	23.6	19.4	22.8	22.7
3.7 ≤ E < 3.9	15.5	16.9	21.5	23.2	19.0	22.5	22.4
3.9 ≤ E < 4.1	15.2	16.5	21.2	22.9	18.6	22.1	22.1
4.1 ≤ E < 4.3	14.9	16.2	20.9	22.6	18.3	21.8	21.8
4.3 ≤ E < 4.5	14.6	15.9	20.5	22.3	18.0	21.6	21.6
4.5 ≤ E < 4.7	14.3	15.6	20.3	22.0	17.7	21.3	21.3
4.7 ≤ E < 4.9	14.0	15.4	20.1	21.8	17.5	21.1	21.0
E ≥ 4.9	13.8	15.2	19.8	21.6	17.3	20.8	20.7

Table 5.8.9-5 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	17.7	19.1	23.6	25.3	21.1	24.5	24.5
3.3 ≤ E < 3.5	17.3	18.7	23.3	25.0	20.7	24.2	24.2
3.5 ≤ E < 3.7	16.8	18.3	22.9	24.6	20.4	23.9	23.9
3.7 ≤ E < 3.9	16.4	17.9	22.6	24.3	20.0	23.6	23.5
3.9 ≤ E < 4.1	16.1	17.6	22.2	24.0	19.7	23.3	23.2
4.1 ≤ E < 4.3	15.8	17.3	21.9	23.7	19.3	23.0	22.9
4.3 ≤ E < 4.5	15.5	17.0	21.6	23.4	19.0	22.7	22.6
4.5 ≤ E < 4.7	15.2	16.7	21.4	23.2	18.8	22.4	22.4
4.7 ≤ E < 4.9	15.0	16.4	21.2	22.9	18.5	22.2	22.1
E ≥ 4.9	14.7	16.1	20.9	22.7	18.3	21.9	21.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	18.2	19.7	24.3	26.0	21.8	24.8	24.7
3.5 ≤ E < 3.7	17.8	19.3	23.9	25.7	21.4	24.4	24.3
3.7 ≤ E < 3.9	17.4	18.9	23.6	25.4	21.1	24.1	24.0
3.9 ≤ E < 4.1	17.1	18.6	23.3	25.1	20.7	23.8	23.7
4.1 ≤ E < 4.3	16.7	18.2	23.0	24.8	20.4	23.5	23.4
4.3 ≤ E < 4.5	16.4	17.9	22.8	24.5	20.1	23.2	23.1
4.5 ≤ E < 4.7	16.1	17.6	22.4	24.2	19.8	22.9	22.9
4.7 ≤ E < 4.9	15.9	17.4	22.1	24.0	19.5	22.7	22.6
E ≥ 4.9	15.6	17.1	21.9	23.7	19.3	22.5	22.4

5.8.9.2 BWR

Fuel assembly loading tables are generated for a uniform cask heat load of 33 kW (379 W/assy). Minimum cool times are summarized in Table 5.8.9-7.

Allowed low burnup (up to 30,000 MWd/MTU) fuel loadings are shown in Table 5.8.9-6. Note that the listed minimum cool times at each burnup step are bounding for all fuel types and initial enrichments above the minimum enrichment specified. Collapsing the fuel type and initial enrichment dependent minimum cool time matrix to a single value may result in a minimum cool time longer than individual values presented for higher burnups in Table 5.8.9-7.

Table 5.8.9-6 Low Burnup BWR Fuel Loading Table

Max. Assembly Avg. Burnup (MWd/MTU)	Min. Assembly Avg. Initial Enrichment (wt% ^{235}U)	Minimum Cool Time (yrs)
10,000	1.3	4.0
15,000	1.5	4.0
20,000	1.7	4.0
25,000	1.9	4.0
30,000	2.1	4.3

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	4.3	4.6	4.0	4.5	4.0	4.5	4.4
2.3 ≤ E < 2.5	4.2	4.6	4.0	4.5	4.0	4.4	4.4
2.5 ≤ E < 2.7	4.2	4.5	4.0	4.4	4.0	4.4	4.3
2.7 ≤ E < 2.9	4.1	4.5	4.0	4.4	4.0	4.3	4.3
2.9 ≤ E < 3.1	4.1	4.4	4.0	4.3	4.0	4.3	4.2
3.1 ≤ E < 3.3	4.0	4.4	4.0	4.3	4.0	4.2	4.2
3.3 ≤ E < 3.5	4.0	4.3	4.0	4.2	4.0	4.2	4.1
3.5 ≤ E < 3.7	4.0	4.3	4.0	4.2	4.0	4.2	4.1
3.7 ≤ E < 3.9	4.0	4.3	4.0	4.2	4.0	4.1	4.0
3.9 ≤ E < 4.1	4.0	4.2	4.0	4.1	4.0	4.1	4.0
4.1 ≤ E < 4.3	4.0	4.2	4.0	4.1	4.0	4.1	4.0
4.3 ≤ E < 4.5	4.0	4.2	4.0	4.1	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.1	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.1	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.1	4.0	4.0	4.0	4.0	4.0
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.7	5.0	4.3	4.9	4.0	4.9	4.8
2.5 ≤ E < 2.7	4.6	4.9	4.3	4.8	4.0	4.8	4.7
2.7 ≤ E < 2.9	4.5	4.9	4.2	4.8	4.0	4.7	4.6
2.9 ≤ E < 3.1	4.5	4.8	4.2	4.7	4.0	4.7	4.6
3.1 ≤ E < 3.3	4.4	4.8	4.1	4.7	4.0	4.6	4.5
3.3 ≤ E < 3.5	4.4	4.7	4.0	4.6	4.0	4.6	4.5
3.5 ≤ E < 3.7	4.3	4.7	4.0	4.6	4.0	4.5	4.5
3.7 ≤ E < 3.9	4.3	4.6	4.0	4.5	4.0	4.5	4.4
3.9 ≤ E < 4.1	4.2	4.6	4.0	4.5	4.0	4.5	4.4
4.1 ≤ E < 4.3	4.2	4.5	4.0	4.5	4.0	4.4	4.3
4.3 ≤ E < 4.5	4.2	4.5	4.0	4.4	4.0	4.4	4.3
4.5 ≤ E < 4.7	4.1	4.5	4.0	4.4	4.0	4.4	4.3
4.7 ≤ E < 4.9	4.1	4.5	4.0	4.4	4.0	4.3	4.2
E ≥ 4.9	4.1	4.4	4.0	4.3	4.0	4.3	4.2

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	5.2	5.6	4.7	5.4	4.4	5.4	5.2
2.5 ≤ E < 2.7	5.1	5.5	4.7	5.3	4.3	5.3	5.2
2.7 ≤ E < 2.9	5.0	5.4	4.6	5.3	4.3	5.2	5.1
2.9 ≤ E < 3.1	4.9	5.4	4.5	5.2	4.2	5.1	5.0
3.1 ≤ E < 3.3	4.9	5.3	4.5	5.1	4.1	5.1	4.9
3.3 ≤ E < 3.5	4.8	5.2	4.4	5.0	4.1	5.0	4.9
3.5 ≤ E < 3.7	4.8	5.1	4.4	5.0	4.0	4.9	4.8
3.7 ≤ E < 3.9	4.7	5.1	4.3	4.9	4.0	4.9	4.8
3.9 ≤ E < 4.1	4.6	5.0	4.3	4.9	4.0	4.9	4.7
4.1 ≤ E < 4.3	4.6	5.0	4.3	4.9	4.0	4.8	4.7
4.3 ≤ E < 4.5	4.6	4.9	4.2	4.8	4.0	4.8	4.7
4.5 ≤ E < 4.7	4.5	4.9	4.2	4.8	4.0	4.7	4.6
4.7 ≤ E < 4.9	4.5	4.9	4.1	4.7	4.0	4.7	4.6
E ≥ 4.9	4.5	4.9	4.1	4.7	4.0	4.7	4.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.7	6.1	5.2	5.9	4.7	5.9	5.7
2.7 ≤ E < 2.9	5.6	6.0	5.1	5.8	4.6	5.8	5.7
2.9 ≤ E < 3.1	5.5	5.9	5.0	5.8	4.6	5.7	5.6
3.1 ≤ E < 3.3	5.5	5.9	4.9	5.7	4.5	5.6	5.5
3.3 ≤ E < 3.5	5.4	5.8	4.9	5.6	4.4	5.6	5.4
3.5 ≤ E < 3.7	5.3	5.7	4.8	5.6	4.4	5.5	5.4
3.7 ≤ E < 3.9	5.2	5.7	4.7	5.5	4.3	5.4	5.3
3.9 ≤ E < 4.1	5.2	5.6	4.7	5.4	4.3	5.4	5.2
4.1 ≤ E < 4.3	5.1	5.6	4.6	5.4	4.3	5.3	5.2
4.3 ≤ E < 4.5	5.0	5.5	4.6	5.3	4.2	5.3	5.1
4.5 ≤ E < 4.7	5.0	5.5	4.5	5.3	4.2	5.2	5.0
4.7 ≤ E < 4.9	5.0	5.4	4.5	5.2	4.1	5.2	5.0
E ≥ 4.9	4.9	5.4	4.5	5.2	4.1	5.1	5.0

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.0	6.5	5.4	6.2	4.9	6.1	6.0
2.7 ≤ E < 2.9	5.9	6.4	5.3	6.1	4.8	6.0	5.9
2.9 ≤ E < 3.1	5.8	6.2	5.2	6.0	4.7	5.9	5.8
3.1 ≤ E < 3.3	5.7	6.1	5.1	5.9	4.7	5.9	5.7
3.3 ≤ E < 3.5	5.6	6.0	5.0	5.9	4.6	5.8	5.6
3.5 ≤ E < 3.7	5.5	6.0	5.0	5.8	4.5	5.7	5.6
3.7 ≤ E < 3.9	5.5	5.9	4.9	5.7	4.5	5.7	5.5
3.9 ≤ E < 4.1	5.4	5.9	4.9	5.7	4.4	5.6	5.5
4.1 ≤ E < 4.3	5.3	5.8	4.8	5.6	4.4	5.5	5.4
4.3 ≤ E < 4.5	5.3	5.8	4.8	5.6	4.4	5.5	5.3
4.5 ≤ E < 4.7	5.2	5.7	4.7	5.5	4.3	5.4	5.3
4.7 ≤ E < 4.9	5.2	5.7	4.7	5.5	4.3	5.4	5.2
E ≥ 4.9	5.1	5.6	4.6	5.4	4.2	5.4	5.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.3	6.8	5.6	6.5	5.1	6.4	6.2
2.7 ≤ E < 2.9	6.2	6.7	5.5	6.4	5.0	6.3	6.1
2.9 ≤ E < 3.1	6.0	6.6	5.5	6.3	4.9	6.2	6.0
3.1 ≤ E < 3.3	6.0	6.5	5.4	6.2	4.8	6.1	5.9
3.3 ≤ E < 3.5	5.9	6.4	5.3	6.1	4.8	6.0	5.9
3.5 ≤ E < 3.7	5.8	6.3	5.2	6.0	4.7	5.9	5.8
3.7 ≤ E < 3.9	5.7	6.2	5.1	5.9	4.6	5.9	5.7
3.9 ≤ E < 4.1	5.6	6.1	5.0	5.9	4.6	5.8	5.7
4.1 ≤ E < 4.3	5.6	6.0	5.0	5.8	4.5	5.8	5.6
4.3 ≤ E < 4.5	5.5	6.0	4.9	5.8	4.5	5.7	5.6
4.5 ≤ E < 4.7	5.5	5.9	4.9	5.7	4.5	5.7	5.5
4.7 ≤ E < 4.9	5.4	5.9	4.9	5.7	4.4	5.6	5.5
E ≥ 4.9	5.4	5.8	4.8	5.6	4.4	5.6	5.4

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.6	7.1	5.9	6.8	5.3	6.8	6.6
2.7 ≤ E < 2.9	6.5	7.0	5.8	6.7	5.2	6.6	6.4
2.9 ≤ E < 3.1	6.4	6.9	5.7	6.6	5.1	6.5	6.3
3.1 ≤ E < 3.3	6.3	6.8	5.6	6.5	5.0	6.4	6.2
3.3 ≤ E < 3.5	6.1	6.7	5.5	6.4	4.9	6.3	6.1
3.5 ≤ E < 3.7	6.0	6.6	5.4	6.3	4.9	6.2	6.0
3.7 ≤ E < 3.9	6.0	6.5	5.4	6.2	4.8	6.1	5.9
3.9 ≤ E < 4.1	5.9	6.4	5.3	6.1	4.8	6.0	5.9
4.1 ≤ E < 4.3	5.8	6.3	5.2	6.0	4.7	6.0	5.8
4.3 ≤ E < 4.5	5.8	6.3	5.1	6.0	4.6	5.9	5.8
4.5 ≤ E < 4.7	5.7	6.2	5.1	6.0	4.6	5.9	5.7
4.7 ≤ E < 4.9	5.7	6.1	5.0	5.9	4.6	5.9	5.7
E ≥ 4.9	5.6	6.1	5.0	5.9	4.5	5.8	5.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	7.0	7.6	6.1	7.2	5.5	7.1	6.9
2.7 ≤ E < 2.9	6.8	7.4	6.0	7.0	5.4	6.9	6.7
2.9 ≤ E < 3.1	6.7	7.3	5.9	6.9	5.3	6.8	6.6
3.1 ≤ E < 3.3	6.6	7.1	5.8	6.8	5.2	6.7	6.5
3.3 ≤ E < 3.5	6.5	7.0	5.7	6.7	5.1	6.6	6.4
3.5 ≤ E < 3.7	6.4	6.9	5.7	6.6	5.0	6.5	6.3
3.7 ≤ E < 3.9	6.3	6.8	5.6	6.5	5.0	6.5	6.2
3.9 ≤ E < 4.1	6.2	6.7	5.5	6.4	4.9	6.4	6.1
4.1 ≤ E < 4.3	6.1	6.7	5.5	6.4	4.9	6.3	6.0
4.3 ≤ E < 4.5	6.0	6.6	5.4	6.3	4.8	6.2	6.0
4.5 ≤ E < 4.7	5.9	6.5	5.3	6.2	4.8	6.1	5.9
4.7 ≤ E < 4.9	5.9	6.5	5.3	6.2	4.7	6.1	5.9
E ≥ 4.9	5.8	6.4	5.2	6.1	4.7	6.0	5.9

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.2	7.9	6.3	7.5	5.6	7.4	7.1
2.9 ≤ E < 3.1	7.0	7.7	6.2	7.3	5.5	7.2	6.9
3.1 ≤ E < 3.3	6.9	7.6	6.1	7.1	5.4	7.0	6.8
3.3 ≤ E < 3.5	6.8	7.4	6.0	7.0	5.4	6.9	6.7
3.5 ≤ E < 3.7	6.7	7.3	5.9	6.9	5.3	6.9	6.6
3.7 ≤ E < 3.9	6.6	7.2	5.8	6.8	5.2	6.8	6.5
3.9 ≤ E < 4.1	6.5	7.1	5.8	6.8	5.1	6.7	6.4
4.1 ≤ E < 4.3	6.4	7.0	5.7	6.7	5.0	6.6	6.3
4.3 ≤ E < 4.5	6.3	6.9	5.6	6.6	5.0	6.5	6.3
4.5 ≤ E < 4.7	6.3	6.8	5.6	6.5	4.9	6.4	6.2
4.7 ≤ E < 4.9	6.2	6.8	5.5	6.5	4.9	6.4	6.1
E ≥ 4.9	6.1	6.7	5.4	6.4	4.8	6.3	6.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.7	8.3	6.7	7.9	5.9	7.8	7.5
2.9 ≤ E < 3.1	7.5	8.1	6.5	7.7	5.8	7.6	7.3
3.1 ≤ E < 3.3	7.3	8.0	6.4	7.6	5.7	7.5	7.1
3.3 ≤ E < 3.5	7.2	7.8	6.3	7.4	5.6	7.3	7.0
3.5 ≤ E < 3.7	7.0	7.7	6.1	7.3	5.5	7.2	6.9
3.7 ≤ E < 3.9	6.9	7.6	6.0	7.2	5.4	7.0	6.8
3.9 ≤ E < 4.1	6.8	7.5	6.0	7.1	5.3	7.0	6.7
4.1 ≤ E < 4.3	6.7	7.4	5.9	7.0	5.3	6.9	6.7
4.3 ≤ E < 4.5	6.7	7.3	5.8	6.9	5.2	6.8	6.6
4.5 ≤ E < 4.7	6.6	7.2	5.8	6.8	5.1	6.7	6.5
4.7 ≤ E < 4.9	6.5	7.1	5.7	6.8	5.1	6.7	6.4
E ≥ 4.9	6.4	7.0	5.7	6.7	5.0	6.6	6.4

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.1	8.9	7.0	8.4	6.1	8.2	7.9
2.9 ≤ E < 3.1	8.0	8.7	6.8	8.2	6.0	8.0	7.7
3.1 ≤ E < 3.3	7.8	8.5	6.7	8.0	5.9	7.9	7.6
3.3 ≤ E < 3.5	7.6	8.3	6.6	7.8	5.8	7.7	7.4
3.5 ≤ E < 3.7	7.5	8.1	6.5	7.7	5.7	7.6	7.3
3.7 ≤ E < 3.9	7.3	8.0	6.4	7.6	5.6	7.5	7.2
3.9 ≤ E < 4.1	7.2	7.9	6.3	7.5	5.5	7.4	7.0
4.1 ≤ E < 4.3	7.1	7.8	6.2	7.4	5.5	7.2	7.0
4.3 ≤ E < 4.5	7.0	7.7	6.1	7.2	5.4	7.1	6.9
4.5 ≤ E < 4.7	6.9	7.6	6.0	7.2	5.3	7.0	6.8
4.7 ≤ E < 4.9	6.8	7.5	5.9	7.1	5.3	7.0	6.7
E ≥ 4.9	6.8	7.4	5.9	7.0	5.2	6.9	6.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.7	9.5	7.4	8.9	6.4	8.7	8.3
2.9 ≤ E < 3.1	8.4	9.2	7.2	8.7	6.3	8.5	8.1
3.1 ≤ E < 3.3	8.2	9.0	7.0	8.5	6.1	8.3	7.9
3.3 ≤ E < 3.5	8.0	8.8	6.9	8.3	6.0	8.2	7.8
3.5 ≤ E < 3.7	7.9	8.7	6.8	8.1	5.9	8.0	7.7
3.7 ≤ E < 3.9	7.8	8.5	6.7	8.0	5.8	7.9	7.6
3.9 ≤ E < 4.1	7.6	8.3	6.6	7.9	5.8	7.8	7.4
4.1 ≤ E < 4.3	7.5	8.2	6.5	7.8	5.7	7.7	7.3
4.3 ≤ E < 4.5	7.4	8.1	6.4	7.7	5.6	7.6	7.2
4.5 ≤ E < 4.7	7.3	8.0	6.3	7.6	5.6	7.5	7.1
4.7 ≤ E < 4.9	7.2	7.9	6.2	7.5	5.5	7.4	7.0
E ≥ 4.9	7.1	7.8	6.1	7.4	5.4	7.3	7.0

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	9.3	10.1	7.8	9.5	6.7	9.3	8.8
2.9 ≤ E < 3.1	9.0	9.9	7.6	9.2	6.6	9.0	8.7
3.1 ≤ E < 3.3	8.8	9.6	7.4	9.0	6.4	8.9	8.4
3.3 ≤ E < 3.5	8.6	9.4	7.3	8.8	6.3	8.7	8.2
3.5 ≤ E < 3.7	8.4	9.2	7.1	8.6	6.2	8.5	8.1
3.7 ≤ E < 3.9	8.3	9.0	7.0	8.5	6.1	8.3	7.9
3.9 ≤ E < 4.1	8.1	8.9	6.9	8.3	6.0	8.2	7.8
4.1 ≤ E < 4.3	8.0	8.7	6.8	8.2	5.9	8.1	7.7
4.3 ≤ E < 4.5	7.8	8.6	6.7	8.0	5.8	7.9	7.6
4.5 ≤ E < 4.7	7.7	8.5	6.6	8.0	5.8	7.9	7.5
4.7 ≤ E < 4.9	7.6	8.4	6.5	7.9	5.7	7.8	7.4
E ≥ 4.9	7.5	8.2	6.5	7.8	5.6	7.7	7.4

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	9.6	10.6	8.0	9.8	6.9	9.7	9.2
3.1 ≤ E < 3.3	9.4	10.3	7.8	9.6	6.7	9.4	8.9
3.3 ≤ E < 3.5	9.2	10.0	7.7	9.4	6.6	9.2	8.8
3.5 ≤ E < 3.7	8.9	9.8	7.5	9.2	6.5	9.0	8.6
3.7 ≤ E < 3.9	8.8	9.6	7.4	9.0	6.4	8.8	8.4
3.9 ≤ E < 4.1	8.6	9.5	7.3	8.9	6.3	8.7	8.3
4.1 ≤ E < 4.3	8.4	9.3	7.1	8.7	6.1	8.6	8.1
4.3 ≤ E < 4.5	8.3	9.1	7.0	8.6	6.0	8.4	8.0
4.5 ≤ E < 4.7	8.1	9.0	6.9	8.5	6.0	8.3	7.9
4.7 ≤ E < 4.9	8.0	8.9	6.8	8.3	5.9	8.2	7.8
E ≥ 4.9	7.9	8.8	6.8	8.2	5.9	8.1	7.7

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	10.4	11.4	8.6	10.6	7.2	10.3	9.7
3.1 ≤ E < 3.3	10.0	11.1	8.4	10.3	7.0	10.0	9.6
3.3 ≤ E < 3.5	9.8	10.8	8.1	10.0	6.9	9.8	9.3
3.5 ≤ E < 3.7	9.5	10.5	8.0	9.7	6.8	9.6	9.0
3.7 ≤ E < 3.9	9.3	10.3	7.8	9.5	6.6	9.4	8.9
3.9 ≤ E < 4.1	9.1	10.0	7.7	9.4	6.6	9.2	8.8
4.1 ≤ E < 4.3	9.0	9.8	7.5	9.2	6.5	9.1	8.6
4.3 ≤ E < 4.5	8.8	9.7	7.4	9.0	6.3	8.9	8.5
4.5 ≤ E < 4.7	8.7	9.6	7.3	8.9	6.3	8.8	8.4
4.7 ≤ E < 4.9	8.5	9.4	7.2	8.8	6.2	8.7	8.2
E ≥ 4.9	8.4	9.3	7.1	8.7	6.1	8.6	8.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.1	12.1	9.1	11.3	7.6	11.1	10.5
3.1 ≤ E < 3.3	10.8	11.8	8.9	11.0	7.4	10.8	10.2
3.3 ≤ E < 3.5	10.5	11.6	8.6	10.7	7.3	10.5	9.9
3.5 ≤ E < 3.7	10.2	11.2	8.4	10.4	7.1	10.2	9.7
3.7 ≤ E < 3.9	10.0	11.1	8.3	10.2	7.0	10.0	9.4
3.9 ≤ E < 4.1	9.8	10.8	8.1	10.0	6.8	9.8	9.3
4.1 ≤ E < 4.3	9.6	10.6	7.9	9.8	6.7	9.6	9.1
4.3 ≤ E < 4.5	9.4	10.3	7.8	9.6	6.6	9.5	9.0
4.5 ≤ E < 4.7	9.2	10.2	7.7	9.5	6.5	9.3	8.8
4.7 ≤ E < 4.9	9.1	10.1	7.6	9.4	6.5	9.2	8.7
E ≥ 4.9	8.9	9.9	7.5	9.2	6.4	9.0	8.6

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.9	13.0	9.6	12.0	8.0	11.8	11.2
3.1 ≤ E < 3.3	11.5	12.7	9.4	11.7	7.8	11.5	10.9
3.3 ≤ E < 3.5	11.2	12.4	9.1	11.4	7.6	11.2	10.6
3.5 ≤ E < 3.7	11.0	12.0	8.9	11.1	7.5	10.9	10.3
3.7 ≤ E < 3.9	10.7	11.7	8.7	10.9	7.3	10.7	10.0
3.9 ≤ E < 4.1	10.4	11.5	8.6	10.7	7.2	10.5	9.9
4.1 ≤ E < 4.3	10.2	11.3	8.4	10.5	7.0	10.3	9.7
4.3 ≤ E < 4.5	10.0	11.1	8.2	10.3	6.9	10.0	9.5
4.5 ≤ E < 4.7	9.8	10.9	8.1	10.1	6.8	9.9	9.4
4.7 ≤ E < 4.9	9.7	10.7	8.0	10.0	6.7	9.8	9.2
E ≥ 4.9	9.5	10.6	7.9	9.8	6.7	9.6	9.1
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	12.7	13.8	10.4	12.9	8.5	12.6	11.9
3.1 ≤ E < 3.3	12.3	13.6	10.0	12.6	8.3	12.3	11.6
3.3 ≤ E < 3.5	11.9	13.2	9.8	12.1	8.0	11.9	11.3
3.5 ≤ E < 3.7	11.6	12.9	9.5	11.9	7.9	11.7	11.0
3.7 ≤ E < 3.9	11.4	12.6	9.2	11.7	7.7	11.4	10.7
3.9 ≤ E < 4.1	11.2	12.3	9.0	11.4	7.5	11.2	10.6
4.1 ≤ E < 4.3	11.0	12.0	8.9	11.2	7.4	11.0	10.3
4.3 ≤ E < 4.5	10.8	11.8	8.7	11.0	7.3	10.8	10.0
4.5 ≤ E < 4.7	10.5	11.6	8.6	10.8	7.1	10.6	9.9
4.7 ≤ E < 4.9	10.3	11.5	8.4	10.6	7.0	10.4	9.8
E ≥ 4.9	10.2	11.3	8.3	10.5	7.0	10.2	9.6

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	13.2	14.4	10.7	13.4	8.7	13.1	12.4
3.3 ≤ E < 3.5	12.8	14.1	10.4	13.1	8.5	12.8	11.9
3.5 ≤ E < 3.7	12.5	13.7	10.0	12.7	8.3	12.5	11.7
3.7 ≤ E < 3.9	12.2	13.4	9.9	12.4	8.1	12.2	11.5
3.9 ≤ E < 4.1	11.9	13.2	9.7	12.1	7.9	11.9	11.2
4.1 ≤ E < 4.3	11.6	12.8	9.4	11.9	7.8	11.7	11.0
4.3 ≤ E < 4.5	11.5	12.7	9.3	11.7	7.6	11.5	10.8
4.5 ≤ E < 4.7	11.2	12.4	9.0	11.5	7.5	11.3	10.6
4.7 ≤ E < 4.9	11.1	12.2	8.9	11.3	7.4	11.1	10.4
E ≥ 4.9	10.9	12.0	8.8	11.2	7.3	10.9	10.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	13.9	15.4	11.4	14.2	9.2	14.0	13.2
3.3 ≤ E < 3.5	13.6	15.0	11.1	13.9	9.0	13.6	12.9
3.5 ≤ E < 3.7	13.2	14.7	10.8	13.5	8.8	13.3	12.5
3.7 ≤ E < 3.9	12.8	14.3	10.5	13.2	8.5	13.0	12.1
3.9 ≤ E < 4.1	12.5	14.0	10.3	13.0	8.3	12.8	11.9
4.1 ≤ E < 4.3	12.3	13.7	10.0	12.7	8.2	12.5	11.7
4.3 ≤ E < 4.5	12.1	13.5	9.8	12.5	8.0	12.2	11.5
4.5 ≤ E < 4.7	11.9	13.2	9.6	12.2	7.9	12.0	11.3
4.7 ≤ E < 4.9	11.6	13.0	9.5	12.0	7.8	11.8	11.1
E ≥ 4.9	11.5	12.8	9.3	11.8	7.7	11.6	10.9

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	14.8	16.3	12.2	15.2	9.8	14.9	14.0
3.3 ≤ E < 3.5	14.5	16.0	11.8	14.8	9.5	14.5	13.6
3.5 ≤ E < 3.7	14.1	15.6	11.5	14.4	9.2	14.1	13.4
3.7 ≤ E < 3.9	13.7	15.2	11.3	14.1	9.0	13.8	13.0
3.9 ≤ E < 4.1	13.5	14.9	11.0	13.8	8.8	13.5	12.7
4.1 ≤ E < 4.3	13.2	14.6	10.7	13.5	8.6	13.2	12.4
4.3 ≤ E < 4.5	12.9	14.3	10.5	13.3	8.5	12.9	12.2
4.5 ≤ E < 4.7	12.7	14.1	10.3	13.0	8.3	12.7	12.0
4.7 ≤ E < 4.9	12.4	13.9	10.0	12.8	8.1	12.6	11.7
E ≥ 4.9	12.2	13.7	9.9	12.6	8.0	12.4	11.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	15.7	17.3	13.0	16.1	10.5	15.9	14.9
3.3 ≤ E < 3.5	15.3	17.0	12.6	15.7	10.1	15.4	14.5
3.5 ≤ E < 3.7	15.0	16.5	12.3	15.3	9.8	15.1	14.2
3.7 ≤ E < 3.9	14.6	16.1	11.9	15.0	9.6	14.7	13.8
3.9 ≤ E < 4.1	14.3	15.9	11.6	14.6	9.3	14.4	13.5
4.1 ≤ E < 4.3	13.9	15.5	11.4	14.3	9.1	14.0	13.3
4.3 ≤ E < 4.5	13.7	15.2	11.2	14.1	8.9	13.9	13.0
4.5 ≤ E < 4.7	13.5	15.0	10.9	13.9	8.8	13.6	12.7
4.7 ≤ E < 4.9	13.2	14.7	10.7	13.7	8.6	13.3	12.5
E ≥ 4.9	12.9	14.5	10.5	13.4	8.5	13.1	12.3

Table 5.8.9-7 Loading Table for BWR Fuel – 379 W/assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	16.7	18.3	13.8	17.1	11.1	16.8	15.8
3.3 ≤ E < 3.5	16.2	17.9	13.4	16.6	10.8	16.3	15.4
3.5 ≤ E < 3.7	15.8	17.5	13.1	16.3	10.4	16.0	15.0
3.7 ≤ E < 3.9	15.5	17.1	12.7	15.9	10.2	15.6	14.6
3.9 ≤ E < 4.1	15.2	16.8	12.4	15.6	9.9	15.3	14.4
4.1 ≤ E < 4.3	14.9	16.5	12.0	15.3	9.7	15.0	14.0
4.3 ≤ E < 4.5	14.6	16.2	11.8	15.0	9.4	14.7	13.7
4.5 ≤ E < 4.7	14.3	15.9	11.6	14.7	9.3	14.4	13.5
4.7 ≤ E < 4.9	14.0	15.6	11.4	14.4	9.0	14.2	13.3
E ≥ 4.9	13.8	15.4	11.2	14.2	8.9	14.0	13.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	17.2	18.8	14.1	17.5	11.4	17.3	16.4
3.5 ≤ E < 3.7	16.8	18.5	13.7	17.2	11.1	17.0	15.9
3.7 ≤ E < 3.9	16.5	18.1	13.4	16.9	10.8	16.5	15.5
3.9 ≤ E < 4.1	16.0	17.7	13.0	16.4	10.5	16.2	15.2
4.1 ≤ E < 4.3	15.7	17.4	12.7	16.1	10.2	15.9	14.9
4.3 ≤ E < 4.5	15.4	17.1	12.5	15.9	10.0	15.6	14.6
4.5 ≤ E < 4.7	15.1	16.8	12.2	15.6	9.8	15.3	14.4
4.7 ≤ E < 4.9	14.9	16.5	11.9	15.3	9.6	15.1	14.0
E ≥ 4.9	14.7	16.3	11.7	15.1	9.4	14.8	13.8

Chapter 9

Chapter 9
Operating Procedures

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9.1 Loading MAGNASTOR

MAGNASTOR is used to load, transfer, and store spent fuel. The three principal components of the system are: the transportable storage canister (TSC), the transfer cask, and the concrete cask. The transfer cask contains and supports the TSC during fuel loading, lid welding and closure operations. The transfer cask, with the transfer adapter, is also used to move the TSC into position for placement in the concrete cask.

These loading procedures are based on three initial conditions.

- the transfer cask is located in a facility's designated workstation for cask preparation
- an empty TSC (properly receipt inspected and accepted) is located in the transfer cask cavity
- an accepted concrete cask is available to receive the TSC when loading and preparation activities are complete

The TSC is filled with clean or pool water and the transfer cask containing the TSC is lowered into the spent fuel pool for fuel assembly loading and verification. The user must identify and select the fuel assemblies to be loaded and ensure that all loaded fuel assemblies comply with the Approved Content provisions of the CoC.

Following fuel loading, the closure lid is installed and the transfer cask containing the loaded TSC is lifted from the bottom of the spent fuel pool. The TSC is partially drained and the closure lid is welded to the TSC shell. The closure lid-to-shell weld is visual and progressive dye penetrant examined. The cavity is refilled and the TSC is subjected to a hydrostatic pressure test with no loss in pressure or observable leakage allowed. Following hydrostatic pressure test acceptance, the closure ring, which provides the second confinement closure barrier, is installed, welded and inspected. The TSC cavity water is then drained and measured.

The residual moisture in the TSC is then removed by either pressurized helium drying or vacuum drying techniques, and the TSC dryness is verified. The TSC is then evacuated to < 3 torr and backfilled with a known quantity of pressurized helium to provide an inert atmosphere and to establish the convective heat transfer flow for the safe long-term storage of the spent fuel contents. System connections to the vent and drain openings are removed and the inner port covers are installed, welded, helium leakage rate tested, and the welds examined. The outer port covers, which provide the redundant sealing of the confinement boundary, are installed, welded and the welds examined. Installation and welding of the closure lid, closure ring and port covers complete the assembly of the confinement boundary.

The concrete cask is positioned for the transfer of the TSC and the transfer adapter is installed. The transfer cask containing the loaded TSC is positioned on the transfer adapter on the top of

the concrete cask. The TSC is lowered into the concrete cask and the transfer cask and transfer adapter are removed. The concrete lid assembly is installed and secured to complete the loading process.

The loaded concrete cask is moved to the ISFSI storage pad using the site-specific transporter and placed in its long-term storage location. Final radiation surveys are completed and the temperature monitoring system is installed, if used, which completes the MAGNASTOR loading and transfer sequence.

9.1.1 Loading and Closing the TSC

This section describes the sequence of operations to load and close the TSC in preparation for transferring the TSC to the concrete cask. The empty TSC is assumed to be positioned inside the transfer cask located at the designated workstation.

1. Visually inspect the TSC and basket internals for foreign materials or debris.
2. Visually inspect the top of the TSC shell and closure lid weld preps.
3. Inflate the upper transfer cask annulus seal to 25 (+10, -5) psig with air or nitrogen gas. Disconnect the gas supply.

   Note: Either the top or bottom upper annulus seal is used based on the length of the TSC to be loaded.
4. Verify the three TSC retaining blocks are pinned in the retracted position.
5. Verify that at least one lock pin is installed on each transfer cask shield door.
6. Fill the TSC with clean or pool water. For PWR spent fuel contents, the soluble boron concentration in the TSC shall be verified and monitored in accordance with the LCO 3.2.1.
7. Attach the lift yoke to a crane suitable for handling the loaded TSC, transfer cask and yoke. Position the lift yoke over the transfer cask and engage the lift yoke to the two transfer cask trunnions.

   Note: The temperature of the transfer cask (surrounding ambient air temperature) must be verified to be at or above the minimum operating temperature of 0°F.
8. Lift the transfer cask containing the empty TSC and move it to the spent fuel pool following the prescribed load path.

   Note: A protective cover, attached to the bottom of the transfer cask, may be used to prevent imbedding contaminated particles in the shield doors and door rails.
9. Connect the clean water lines to the lower annulus fill ports of the transfer cask. Ensure that the unused ports are closed or capped to prevent pool water in-leakage.

55. Open gas supply valve and start suction pump, if used, and drain water from the TSC until water ceases to flow out of the drain line. Close gas supply valve and stop suction pump.
56. Record the time at the completion of the draining of the TSC. Record the volume of water drained from the TSC (V_{TSC}) as measured by the totalizer.
57. At the option of the user, disconnect suction pump, close discharge line isolation valve, and open gas supply line. Pressurize TSC to 25 (+5, -10) psig and open discharge line isolation valve to blow down the TSC. Repeat blow down operations until no significant water flows out of the drain line.
58. Disconnect the drain line and gas supply line from the drain and vent port quick-disconnects.
59. Dry the TSC cavity using one of the methods described in Step 60 and Step 61 (vacuum drying) or in Step 62 and Step 63 (pressurized helium drying). Ensure time durations established for vacuum drying are not exceeded so that fuel cladding temperatures are maintained below 752°F.

    Note: At the option of the user, the drain and/or vent port quick-disconnects can be removed and replaced temporarily with suitable straight-through fittings to increase flow area cross-section and to reduce resistance to gas flow. The quick-disconnect fittings must be reinstalled and torqued prior to final helium backfill.

60. Vacuum dry the TSC using the vacuum drying system as follows.
    a. Connect the vacuum drying system to the vent and drain port openings.
    b. Operate the vacuum pump until a vapor pressure of < 10 torr is achieved in the TSC. The time durations of the first vacuum drying phase shall be in accordance with the time limits of Table 9.1-3.
    c. Isolate the vacuum pump from the TSC and turn off the vacuum pump. Observe the vacuum gauge connected to the TSC for an increase in pressure for a minimum period of 10 minutes. If the TSC pressure is ≤ 10 torr at the end of 10 minutes, the TSC is dry of free water in accordance with LCO 3.1.1.

    Note: If the dryness verification is not met within the first vacuum drying times defined in Table 9.1-3, the TSC shall be backfilled with helium to 7 bar, gauge, and cooled by the annulus circulating water system, or by placement in the spent fuel pool for a 12-hour (+1,-0) period. After the cooling period, subsequent drying cycle operations can continue for the times indicated in Table 9.1-4. Drying cycles and cooling periods may be continued until the TSC cavity passes the dryness verification per LCO 3.1.1, Condition A.

    Note: If the annulus cooling system becomes inoperable during the vacuum drying operational sequence, backfill the TSC to 7 bar, absolute, and place the TSC

into auxiliary cooling (i.e., placement of the transfer cask with the TSC into the spent fuel pool, or start the auxiliary air cooling system) and maintain the auxiliary cooling until the annulus cooling system is operable.

61. Upon satisfactory completion of the dryness verification, evacuate the TSC cavity to a pressure of ≤ 3 torr. Isolate the vacuum pump, and backfill and pressurize the TSC cavity with 99.995% (minimum) pure helium as follows:
    a. Determine the free volume of the TSC (V_{TSC}) per Step 56.
    b. Multiply the V_{TSC} free volume by the helium loading value per unit volume (L_{helium}) to determine required helium mass (M_{helium}) to be backfilled into the cavity.
    c. Set the helium bottle regulator to 100 (+5,-0) psig.
    d. Connect the helium backfill system to the vent port and reset the mass-flow meter to zero
    e. Slowly open the helium supply valve and backfill the TSC with the required helium mass (M_{helium}) in accordance with LCO 3.1.1.
62. Dry the TSC using the pressurized helium drying system as follows:
    a. Connect the inlet helium gas line for the pressurized helium drying system to the drain port.
    b. Connect the helium discharge line to the vent port.
    c. Using a helium supply system, charge the drying system with 99.995% (minimum) pure helium to a pressure of 70 (±5) psig.
    d. Start the gas circulation pump, or equivalent, and initiate dry helium gas circulation.
    e. Continue helium circulation through the TSC until the measured discharged gas dew point temperature at the vent port meets the dryness criteria of LCO 3.1.1.
63. Stop helium circulation and backfill the TSC with 99.995% (minimum) pure helium per LCO 3.1.1 until the cavity is backfilled with the required helium mass (M_{helium}).
64. Disconnect the vacuum drying system and the helium backfill system, or the pressurized helium drying system, from the vent and drain openings.
65. Install and weld the inner port cover on the drain port opening.
66. Install and weld the inner port cover on the vent port opening.
67. Perform helium leak test on each of the inner port cover welds.
68. Perform visual and PT examinations of the final surface of the port cover welds and record the results.
69. Install and weld the outer port cover on the drain port opening. Perform visual and PT examinations of the final weld surface and record the results.

Table 9.1-1 Major Auxiliary Equipment

Item	Description
Air Pad Rig Set	A device consisting of four air pads, a controller, and an air supply source that lifts the concrete cask using air supplied at a high volume.
Annulus Fill System	System that circulates clean/filtered spent fuel pool water through the transfer cask/TSC annulus using the lower and upper transfer cask fill lines. The system maintains a positive clean water flow/overpressure to minimize the exposure of the TSC external surfaces to contaminated spent fuel pool water.
Annulus Circulating Water System	The system provides a circulating water flow through the annulus to maintain the TSC shell temperature ≤ 150°F during TSC preparation and drying evolutions. The system includes appropriate circulating pump, pressure gauges, and inlet and outlet water thermometer.
Annulus Seals	Inflatable seals provided at the top and bottom of the transfer cask/TSC annulus for use with the annulus fill and cooling system.
Bottom Protective Cover	Optional stainless steel plate attached to the base of the transfer cask to prevent particulate contamination of the transfer cask shield doors and rails.
Canister Upender	Lifting device used to upright a TSC from the horizontal position to a vertical orientation to allow vertical handling for placing the TSC in the transfer cask.
Cask Transporter	A heavy-haul trailer, a rail car, a vertical cask transporter, or other specially designed equipment used onsite to move the concrete cask. The loaded concrete cask is transported vertically resting on its base (requiring a flat-bed transporter) or it is transported vertically suspended from its lifting lugs (requiring a vertical mobile frame).
Closure Lid Lifting Sling System	Sling system used to install the closure lid into the TSC in the spent fuel pool. At the user's option, the sling system can be suspended from the lift yoke and used to install the lid and engage the yoke with one crane sequence.
Cooldown System (CDS)	Introduces nitrogen, helium and cooling water to the TSC cavity to cooldown the TSC internals and stored spent fuel to allow the return of the TSC to the spent fuel pool for the unloading of the fuel assemblies. This system would only be required in the highly unlikely event that a loaded TSC had to be unloaded.

Table 9.1-1 Major Auxiliary Equipment (continued)

Drain and Blow Down System (DBS)	System used to pump out and/or blow down the water from the TSC cavity prior to the start of drying operations, and to refill the cavity and hydrostatic test the closure lid weld. The system includes the appropriate suction pump, piping/hoses, flow meter/totalizer, pressure gauges, and valves to connect to the TSC vent and drain port connections to complete the draining and hydrostatic testing of the cavity.
Hydrogen Detection System	System that detects any concentration of H_2 in the cavity resulting from material reactions during closure lid root pass welding operations and for closure lid weld removal operations.
Helium Mass Spectrometer Leak Detector (MSLD)	A system utilized to perform the helium leakage testing of the inner vent and drain port cover welds.
Lid Retention System	An optional component installed on top of the TSC closure lid to secure the lid during cask handling operations between the spent fuel pool and the workstation used to close the TSC.
Lift Yoke (with Crane Hook Extension, if required)	Device for lifting and moving MAGNASTOR transfer cask by engaging the lifting trunnions.
Loaded TSC Sling System	Redundant sling system (two 3-legged slings) used to transfer a TSC into a concrete cask or a transfer cask and meeting the requirements of ANSI N14.6 and the facility crane. Alternative TSC handling systems that meet site-specific or client requirements and comply with the facility's heavy lift program developed per NUREG-0612 may be utilized.
Pressurized Helium Drying (PHD) System	A pressurized helium gas circulating system connected to the vent and drain connections used to remove residual moisture from the TSC cavity following draining operations using dry helium gas.
Remote/Robotic Welding System	System that completes the closure lid and port cover welds with minimal operator assistance. The system includes video cameras and a recording device to remotely observe the welding activities and to videotape the results of the closure lid PT examinations.
Supplemental Weld Shield	Optional steel plate installed on the closure lid to provide additional shielding to the cask operators during TSC welding, preparation, and test activities. The supplemental weld shield may be installed separately or as the base plate for the welding system.
Vacuum Drying System (VDS)	Optional system that may be used instead of the PHD system to vaporize and remove residual water, water vapor, and oxidizing gases from the TSC cavity prior to backfilling with helium. The VDS includes the appropriate vacuum pump(s), vacuum and pressure gauges, helium supply connections and valves, and hoses to connect the system to the vent and drain connections.
Weld Removal System	Semiautomatic mechanical weld and/or TSC shell cutting system used to remove the closure lid and port cover welds in the unlikely event that a TSC needs to be unloaded.

Table 9.1-2 Threaded Component Torque Values

Threaded Component	Torque Value (ft-lb)
Concrete Cask Lid Bolts	Snug + 1 wrench flat
Concrete Cask Body Extension	Snug + 1 wrench flat
Closure Lid Lifting Hoist Rings • Lid Handling Only • Loaded TSC Handling	 Hand Tight 840 (+40, -40)ft-lb
Drain Tube Connector • Viton, EDPM, or Elastomer Seal • Metallic Seal	 Per seal manufacturer's specs Per seal manufacturer's specs
Vent Port Connector • Viton, EDPM, or Elastomer Seal • Metallic Seal	 Per seal manufacturer's specs Per seal manufacturer's specs
Cover Plate Bolts	Snug + 1 wrench flat
Lift Lug Bolts	550 (+25, -25) ft-lb
Lid Lifting Hoist Rings (lid handling only)	110 (+10, -10)ft-lb

Table 9.1-3 Initial Vacuum Drying Cycle Time Limits

Heat Load (kW)	Time Limit (hours)
15	60
20	41
25	34
30	27
35.5	23

Table 9.1-4 Subsequent Vacuum Drying Cycle Time Limits

Heat Load (kW)	Time Limit (hours)
15	36
35.5	7

Chapter 10

10.1.2.3 Pressure Testing of the TSC

Following completion of the closure lid-to-TSC shell weld during the TSC preparation operations after fuel loading, the TSC shall be hydrostatically pressure tested in accordance with ASME Code, Section III, Subsection NB, NB-6000 requirements as described in Section 9.1.1. The minimum test pressure of 130 psig shall be applied to the drain port connection for a minimum of 10 minutes. The minimum test pressure is 125% of the normal operating pressure of 104 psig. There shall be no loss in pressure or visible water leakage from the closure lid weld during the 10-minute test period. The normal operating pressure and minimum test pressure are identical for both PWR and BWR TSCs.

10.1.3 Leakage Tests

The confinement boundary is defined as the TSC shell weldment, closure lid, and vent and drain port covers. As described in Section 10.1.1, the confinement boundary is designed, fabricated, examined, and tested in accordance with the requirements of the ASME Code, Section III, Subsection NB, except for the code alternatives listed in Table 2.1-2.

Following welding, the TSC shell weldment shall be leakage tested using the evacuated envelope method as described in ASME Code, Section V, Article 10, and ANSI N14.5 to confirm the total leakage rate is less than or equal to 1×10^{-7} ref. cm^3/s at an upstream pressure of 1 atmosphere absolute and a downstream pressure of 0.01 atmosphere absolute, or less. Under these test conditions, this corresponds to a test leakage rate of 2×10^{-7} cm^3/s, helium at standard conditions.

The TSC shell weldment will be closed using a test lid installed over the top of the shell and the cavity evacuated with a vacuum pump to a vacuum of two torr or less. A test envelope will be installed around the TSC enclosing all of the TSC shell confinement welds, evacuated and backfilled to approximately 1 atmosphere absolute with 99.995% (minimum) pure helium. The percentage of helium gas in the test envelope will be accounted for in the determination of the test sensitivity. A mass spectrometer leak detector (MSLD) is attached to the test lid and samples the evacuated volume for helium. The minimum sensitivity of the helium MSLD and test system shall be less than or equal to 1×10^{-7} cm^3/s, helium, which is one-half of the allowable leakage criteria for leaktight.

If helium leakage is detected, the area of leakage shall be identified and repaired in accordance with the ASME Code, Section III, Subsection NB, NB-4450. The complete helium leakage test shall be performed again to the original test acceptance criteria.

Leakage testing of the TSC shell weldment shall be performed in accordance with written and approved procedures, and the test results documented.

Based on the confinement system materials, welding requirements and inspection methods, leakage testing of the closure lid is not required. In order to ensure the integrity of the vent and drain inner port cover welds, a helium leakage test of each weld is performed using the evacuated envelope method, as described in ASME Code, Section V, Article 10, and ANSI N14.5. The leakage test is to confirm that the leakage rate for each port cover is $\leq 1 \times 10^{-7}$ ref. cm^3/s, which corresponds to a helium test leakage rate of $\leq 2 \times 10^{-7}$ ref. cm^3/s. Following inner port cover welding, a test bell is installed over the top of the port cover and the test bell volume is evacuated to a low pressure by a helium Mass Spectrometer Leak Detector (MSLD) system. The minimum sensitivity of the helium MSLD shall be $\leq 1 \times 10^{-7}$ ref. cm^3/s, helium, which is one-half of the allowable leakage criteria for leaktight.

If leakage is detected, the area of leakage shall be identified and repaired in accordance with ASME Code, Section III, Subsection NB, NB-4450. The helium leak test shall be reperformed to the original test acceptance criteria.

10.1.4 Component Tests

10.1.4.1 Valves, Rupture Discs, and Fluid Transport Devices

The MAGNASTOR system design does not include any rupture discs or fluid transport devices. The closure lid vent and drain openings are each closed by valved quick-disconnect nipples. These nipples are recessed into the closure lid and are used during TSC preparation activities to drain, dry, and helium fill the TSC cavity. No credit is taken for the ability of the valved nipples to confine radioactive material. After completion of final helium backfill pressure adjustment, the port covers are welded in the vent and drain openings enclosing the valved nipples. The port covers provide the confinement boundary for the vent and drain openings.

10.1.4.2 Gaskets

The confinement boundary provided by the welded TSC has no mechanical seals or gaskets. The concrete cask includes weather seals at the concrete cask lid to cask interface. These gaskets do not provide a safety function and loss of the gaskets during operation would have no effect on the safe operation of the concrete cask. The gaskets are provided to facilitate concrete cask maintenance by minimizing water intrusion into the gasketed area.

10.1.5 Shielding Tests

The MAGNASTOR system design is analyzed based on the materials of fabrication and their thickness, using conservative shielding codes to evaluate system dose rates at the system's

surface and at selected distances from the surface. The system shield design does not require performance of a shield test.

Following the loading of each MAGNASTOR and its movement to the ISFSI pad, radiological surveys are performed by the system user to establish area access requirements and to confirm that evaluated offsite doses will meet the applicable regulations. These tests are sufficient to identify any significant defect in the shielding effectiveness of the concrete cask.

10.1.6 Neutron Absorber Tests

NOTE

Section 10.1.6.4.5 and Section 10.1.6.4.6 are incorporated into the MAGNASTOR CoC Technical Specification by reference, Paragraph 4.1.1, and may not be deleted or altered in any way without a CoC amendment approval from the NRC. The text in these two sections is shown in bold to distinguish it from other sections.

Neutron absorber materials are included in the design and fabrication of the MAGNASTOR fuel basket assemblies to assist in the control of reactivity, as described in Chapter 6. Criticality safety is dependent upon the neutron absorber material remaining fixed in position on the fuel tubes and containing the required amount of uniformly distributed boron. A neutron absorber material can be a composite of fine particles in a metal matrix or an alloy of boron compounds with aluminum. Fine particles of boron or boron-carbide that are uniformly distributed are required to obtain the best neutron absorption. Three types of neutron absorber materials are commonly used in spent fuel storage and transport cask fuel baskets: Boral (registered trademark of AAR Advanced Structures), borated metal matrix composites (MMC), and borated aluminum alloy. The fabrication of the neutron absorber material is controlled to provide a uniform boron carbide distribution and the specified ^{10}B areal density.

10.1.6.1 Design/Performance Requirements

The MAGNASTOR system utilizes sheets of neutron absorber material that are attached to the sides of the spent fuel storage locations in the fuel baskets. The materials and dimensions of the neutron absorber sheets are defined on license drawings 71160-571 and 71160-572. The material is called out as a metallic composite (includes borated aluminum alloy, borated MMC, and Boral, which are available under various commercial trade names). Incorporating optional neutron absorber materials in the design provides fabrication flexibility for the use of the most economical and available neutron absorber material that meets the critical characteristics necessary to assure criticality safety. The critical design characteristics of the neutron absorber material are:

- A minimum "effective" areal density of 0.036 g/cm^2 ^{10}B for the PWR basket and 0.027 g/cm^2 ^{10}B for the BWR basket; and
- A uniform distribution of boron carbide; and
- A strength at least equivalent to that of 1100 series aluminum at 700°F, which is sufficient to maintain its form; and
- An effective thermal conductivity greater than or equal to that used in the thermal analyses (Chapter 4).

The required minimum actual ^{10}B loading in a neutron absorber sheet is determined based on the effectiveness of the material, i.e., 75% for Boral and 90% for borated aluminum alloys and for borated metal matrix composites. Testing will be used to verify the areal density and the uniform distribution of ^{10}B in the neutron absorber materials. Table 8.8-1 presents a tabulation of the types of neutron absorber materials, the required minimum effective areal density of ^{10}B, and the required minimum as-fabricated areal density of ^{10}B.

The positions of the neutron absorber sheets with their attachments and retainers to the fuel tubes are shown on license drawings 71160-551 and 71160-591. The attachments and retainers ensure that the neutron absorber remains in place for all loading conditions for the lifetime of the canister.

10.1.6.2 Terminology

Applicable terminology definitions for the neutron absorber materials:

acceptance –	tests conducted to determine whether a specific production lot meets selected material properties and characteristics, or both, so that the lot can be accepted for commercial use.
areal density –	for sheets with flat parallel surfaces, the density of the neutron absorber times the thickness of the material.
designer –	the organization responsible for the design or the license holder for the dry cask storage system or transport packaging. The designer is usually the purchaser of the neutron absorber material, either directly or indirectly (through a fabrication subcontractor).
lot –	a quantity of a product or material accumulated under conditions that are considered uniform for sampling purposes.

neutron absorber –	a nuclide that has a large thermal or epithermal neutron absorption cross-section, or both.
neutron absorber material –	a compound, alloy, composite or other material that contains a neutron absorber.
neutron transmission test –	a process in which a material is placed in a thermal neutron beam, and the number of neutrons transmitted through the material in a specified period of time is counted. The observed neutron counting rate may be converted to areal density by performing the same test on a series of calibration standards. The maximum beam area for the transmission test is 1 in^2 (6.45 cm^2).
neutron cross-section –	a measure of the probability that a neutron will interact with a nucleus; a function of the neutron energy and the structure of the interacting nucleus.
packaging –	in transport of radioactive material, the assembly of components necessary to enclose the radioactive contents completely.
qualification –	the process of evaluating and testing, or both, a material produced by a specific manufacturing process to demonstrate uniformity and durability for a specific application.

10.1.6.3 Inspections

After manufacturing, each sheet of neutron absorber material will be visually and dimensionally inspected for damage, embedded foreign material, and dimensional compliance. The neutron absorber sheets are intended to be defect/damage free, but limited defects/damages are acceptable. Allowed defects are discussed in each material specification section that follows. Standard industrial inspections will be performed on the neutron absorber sheets to verify the acceptability of physical characteristics such as dimensions, flatness, straightness, tensile properties (if structural considerations are applicable) or other mechanical properties as appropriate, surface quality and finish. Inspection and testing of the neutron absorber materials will be performed in accordance with written and approved procedures, by appropriately certified personnel, and the inspection and test results will be documented.

10.1.6.4 Specification

Three types of neutron absorber materials are permitted to augment criticality control in the MAGNASTOR fuel baskets – (1) Boral, a clad composite of aluminum and boron carbide; (2) borated metal matrix composites (MMC); and (3) borated aluminum alloy. The required minimum "effective" areal density of ^{10}B in a neutron absorber is defined on license drawings 71160-571 and 71160-572, in Section 1.8, and is based on the fuel basket geometry and on the fuel assembly type and reactivity. The analyses of the fuel baskets do not consider the tensile strength of the neutron absorber material other than that it be sufficient to maintain its form, i.e., at least equivalent to 1100 series aluminum at 700°F. Environmental conditions encountered by the neutron absorber material may include:

- Immersion in water with the associated chemical, temperature and pressure concerns
- Dissimilar materials
- Gamma and neutron radiation fluence
- Dry heat-up rates
- Maximum temperatures

Testing has demonstrated the durability of the neutron absorber materials:

- They will not incur significant damage due to the pressure, temperature, radiation, or corrosion environments that may be present in the loading and storage of spent fuel;
- Aluminum and boron carbide do not react with each other in the range of the maximum temperatures present in the fuel baskets;
- There are no significant changes in mechanical properties due to the fast neutron fluences experienced in spent fuel storage;
- General corrosion does not have time to affect the integrity of the neutron absorber material due to the very short time of immersion in spent fuel pool water.

Thus, it is only necessary to verify the presence, uniform distribution and minimum areal density (effectiveness) of ^{10}B using testing requirements specific to each type of neutron absorber material.

10.1.6.4.1 Boral

Boral is a composite core of blended boron carbide and aluminum powders between outer layers of aluminum. The core is slightly porous. Sheets of Boral are formed and mechanically bonded by hot-rolling ingots of the core material between aluminum sheets. Boral is credited with an effectiveness of 75% of the specified minimum areal density of ^{10}B in Boral based on acceptance testing of the material as described in the following sections. Visual inspections of the Boral sheets will verify the presence of a full core and will identify any cladding damage, cracks or discontinuities, embedded foreign material, or peeled cladding. Evidence of less than a full core, embedded foreign material, cracks or sharp burrs in the cladding is not acceptable. Embedded pieces of B_4C matrix material are not considered foreign material, but such material shall be removed from the surface of the Boral. Scratches, creases or other surface indications are acceptable on the cladding of the Boral, but exposure of the core through the cladding surface of the sheet is not acceptable.

10.1.6.4.2 Borated Metal Matrix Composites - MMC

Borated metal matrix composite (MMC) material can be produced by powder metallurgy, casting or thermal spray methods and consists of fine boron carbide particles in a matrix of aluminum. Borated MMC material is a metallurgically bonded matrix, low porosity product. MMCs are credited with an effectiveness of 90% of the specified minimum areal density of ^{10}B in the borated MMC material based on acceptance testing of the material as described in the following sections. Visual inspections of the sheets of borated MMC material will be based on Aluminum Association recommendations, i.e., blisters and/or widespread rough surface conditions such as die chatter or porosity will not be acceptable, but local or cosmetic conditions such as scratches, nicks, die lines, inclusions, abrasion, isolated pores or discoloration are acceptable.

10.1.6.4.3 Borated Aluminum

Borated aluminum material is a direct chill cast metallurgy product with a uniform fine dispersion of discrete boron particles in a matrix of aluminum. Borated aluminum material is a metallurgically bonded matrix, low porosity product. Borated aluminum is credited with an effectiveness of 90% of the specified minimum areal density of ^{10}B in the borated aluminum material based on acceptance testing of the material as described in the following sections. Visual inspections of the sheets of borated aluminum material will be based on Aluminum Association recommendations, i.e., blisters and/or widespread rough surface conditions such as die chatter or porosity will not be acceptable, but local or cosmetic conditions such as scratches, nicks, die lines, inclusions, abrasion, isolated pores or discoloration are acceptable.

10.1.6.4.4 Thermal Conductivity Testing of Neutron Absorber Material

Thermal conductivity qualification testing of the neutron absorber materials shall conform to ASTM E1225 [15], ASTM E1461 [16], or an equivalent method. The testing shall be performed at room temperature on test coupons taken from production material. Note that thermal conductivity increases slightly with temperature increases.

- Sampling will initially be one test per lot and may be reduced if the first five tests meet the specified minimum thermal conductivity. Additional tests may be performed on the material from a lot whose test result does not meet the required minimum value, but the lot will be rejected if the mean value of the tests does not meet the required minimum value.
- Upon completion of 25 tests of a single type of neutron absorber material having the same aluminum alloy matrix and boron content (in the same compound), further testing may be terminated if the mean value of all of the test results minus two standard deviations meets the specified minimum thermal conductivity. Similarly, testing may be terminated if the matrix of the material changes to an alloy with a larger coefficient of thermal conductivity, or if the boron compound remains the same, but the boron content is reduced.

In the Chapter 4 thermal analyses, the neutron absorber is conservatively evaluated as a 0.125-in nominal thickness sheet (0.1-in thick boron composite core with 0.0125-in thick aluminum face plates - Boral) for the PWR fuel basket and a 0.10-in nominal thickness sheet (0.075-in thick boron composite core with 0.0125-in thick aluminum face plates - Boral) for the BWR fuel basket. The required minimum thermal conductivities for the MAGNASTOR absorbers are as follows.

Minimum Effective Thermal Conductivity - BTU/(hr-in-°F)

Fuel Basket Type	Radial		Axial	
	100°F	500°F	100°F	500°F
PWR	4.565	4.191	4.870	4.754
BWR	4.687	4.335	5.054	5.017

Neutron absorber sheets of borated MMC material or borated aluminum will have higher effective coefficients of thermal conductivity than the Boral sheets evaluated due to their larger aluminum alloy content. The neutron absorber thermal acceptance criterion will be based on the nominal sheet thickness.

Additional thermal conductivity qualification testing of neutron absorber material is not required if certified quality-controlled test results (from an NAC approved supplier) that meet the specified minimum thermal conductivity are available as referenced documentation.

10.1.6.4.5 Acceptance Testing of Neutron Absorber Material by Neutron Transmission

NOTE

Section 10.1.6.4.5 is incorporated into the MAGNASTOR CoC Technical Specification by reference, Paragraph 4.1.1. and may not be deleted or altered in any way without a CoC amendment approval from the NRC. The text in this section is shown in bold to distinguish it from other sections.

Acceptance testing shall be performed to ensure that neutron absorber material properties for sheets in a given production run are in compliance with the materials requirements for the MAGNASTOR fuel baskets and that the process is operating in a satisfactory manner.

Statistical tests may be run to augment findings relating to isotopic content, impurity content or uniformity of the ^{10}B distribution.

- **For neutron absorber materials credited with 90% effectiveness, determination of neutron absorber material acceptance shall be performed by neutron transmission testing of a statistical sample of finished product or test coupons taken from each lot of material to verify the presence, uniform distribution and the minimum areal density of ^{10}B. The definition of lot and associated sampling and testing terminology are provided in this section.**
- **For neutron absorber materials credited with 75% effectiveness, determination of neutron absorber material acceptance may be performed by either neutron transmission or wet chemistry testing of a statistical sample of finished product or test coupons taken from each lot of material to verify the adequacy of ^{10}B content. The wet chemistry method shall demonstrate the repeatability and correlation of the B_4C content relative to neutron transmission testing. The definition of lot and associated sampling and testing terminology are as provided previously in this section.**
- **Neutron transmission testing limits maximum beam area to 1 in^2 (6.45 cm^2).**
- **Based on the MAGNASTOR required minimum effective areal density of ^{10}B – 0.036 g/cm^2 for the PWR basket and 0.027 g/cm^2 for the BWR basket – and the credit taken for the ^{10}B for the criticality analyses, i.e., 75% for Boral and 90% for borated aluminum alloys and for borated metal matrix composites, a required**

minimum areal density for the as-manufactured neutron absorber sheets is established.

- Test locations/coupons shall be well distributed throughout the lot of material, particularly in the areas most likely to contain variances in thickness, and shall not contain unacceptable defects that could inhibit accurate physical and test measurements.
- The neutron absorber sampling plan shall be selected to demonstrate a 95/95 statistical confidence level in the neutron absorber material and shall be implemented in accordance with written and approved procedures. The sampling plan shall require that each of the first 50 sheets of neutron absorber material from a lot, or a coupon taken therefrom, be tested. Thereafter, coupons shall be taken from 10 randomly selected sheets from each set of 50 sheets. This 1 in 5 sampling plan shall continue until there is a change in lot or batch of constituent materials of the sheet (i.e., boron carbide powder or aluminum powder) or a process change. A measured value less than the required minimum areal density of ^{10}B during the reduced inspection results in a rejection, along with rejection of other contiguous sheets, and mandates a return to 100% inspection for the next 50 sheets. The coupons are indelibly marked and recorded for identification. This identification will be used to document the neutron absorber material test results, which become part of the quality record documentation package.
- Neutron transmission testing of the final product or the coupons shall compare the results with those for calibrated standards composed of a homogeneous ^{10}B compound. Other calibrated standards may be used, but those standards must be shown to be equivalent to a homogeneous standard.
- An NAC approved facility with a neutron source and neutron transmission detection capability shall be selected to perform the described tests. The tests will ensure that the neutron absorption capacity of the material tested is equal to, or higher than, the reference calibration standard value and will verify the uniformity of boron distribution.
- For each neutron absorber sheet, the acceptance criterion is established from a statistical analysis of the test results for the lot of which it was a part. The minimum ^{10}B areal density is determined by reducing the nominal measured areal density by 3 standard deviations, based on the number of neutrons counted, to account for statistical variations in testing. This minimum ^{10}B areal density is converted to volume density by dividing by the neutron absorber thickness at the test location. Then, the lower tolerance limit of ^{10}B volume density – defined as the mean value

^{10}B volume density for the measurements, less K times the standard deviation, where K is the one-sided tolerance limit factor for a normal distribution with 95% probability and 95% confidence – is determined. The minimum neutron absorber sheet thickness is calculated as the minimum specified value of ^{10}B areal density divided by the lower tolerance limit of ^{10}B volume density. Then, the lower tolerance limit of ^{10}B volume density and the minimum sheet thickness are compared to the specified minimum values to determine the acceptability of each lot of neutron absorber material.

- **Neutron absorber sheets thinner than the larger of the calculated minimum sheet thickness or the drawing defined minimum sheet thickness, shall be considered non-conforming, but local depressions totaling no more than 0.5% of the area of the sheet are acceptable if the thickness at their location is ≥ 90% of the drawing specified minimum sheet thickness.**
- **Alternative test methods for neutron attenuation may include chemical analysis or radiography, or a combination of these two methods. Once validated, these test methods may be considered as acceptable alternatives, equivalent to the neutron attenuation test, to confirm absorber material performance.**
- **All neutron absorber material acceptance verification will be conducted in accordance with the NAC International Quality Assurance Program. The neutron absorber material supplier shall control manufacturing in accordance with the key process controls via a documented quality assurance system (approved by NAC), and the designer shall verify conformance by reviewing the manufacturing records.**
- **Nonconforming material shall be evaluated for acceptance in accordance with the NAC International Quality Assurance Program.**

10.1.6.4.6 Qualification Testing of Neutron Absorber Material

NOTE

Section 10.1.6.4.6 is incorporated into the MAGNASTOR CoC Technical Specification by reference, Paragraph 4.1.1, and may not be deleted or altered in any way without a CoC amendment approval from the NRC. The text in this section is shown in bold to distinguish it from other sections.

Qualification tests for each MAGNASTOR System neutron absorber material and its set of manufacturing processes shall be performed at least once to demonstrate acceptability and durability based on the critical design characteristics, previously defined in this section.

The licensed service life will include a range of environmental conditions associated with short-term transfer operations, normal storage conditions, as well as off-normal and accident storage events. Additional qualification testing is not required for a neutron absorber material previously qualified, i.e., reference can be provided to prior testing with the same, or similar, materials for similar design functions and service conditions.

- Qualification testing is required for: (1) neutron absorber material specifications not previously qualified; (2) neutron absorber material specifications previously qualified, but manufactured by a new supplier; and (3) neutron absorber material specifications previously qualified, but with changes in key process controls. Key process controls for producing the neutron absorber material used for qualification testing shall be the same as those to be used for commercial production.
- Qualification testing shall demonstrate consistency between lots (2 minimum).
- Environmental conditions qualification will be verified by direct testing or by validation by data on the same, or similar, material, i.e., the neutron absorber material is shown to not undergo physical changes that would preclude the performance of its design functions. Conditions encountered by the neutron absorber material may include: short-term immersion in water, exposure to chemical, temperature, pressure, and gamma and neutron radiation environments. Suppliers' testing has shown the durability of the three types of neutron absorber materials that may be used in the MAGNASTOR system by demonstrating that the neutron absorber materials will not incur significant damage due to the pressure, temperature, radiation, or corrosion environments or the short-term water immersion that may occur in the loading and storage of spent fuel.
- Mechanical testing of the neutron absorber materials is not required, since the only related design requirement is that the material have a strength at least equivalent to that of 1100 series aluminum at 700°F that is sufficient to maintain its form. Verification will be by review of supplier-provided mechanical properties. Thermal conductivity qualification testing shall be as previously described in this section.
- The uniformity of the boron carbide distribution in the material shall be verified by neutron transmission testing of a statistically significant number of measurements of the areal density at locations distributed throughout the test material production run, i.e., from the ends and the middle. The designer shall define the allowable difference between the measured maximum and minimum ^{10}B areal densities.

- **Testing to determine the minimum ^{10}B areal density shall be performed for the test material production run at a minimum of 25 distributed locations on each sheet of material. One standard deviation of the sampling shall be less that 5% of the sample mean. The ^{10}B areal density testing may be by the neutron transmission method similar to that described previously in this section for Acceptance Testing or by chemical analysis.**
- **A material qualification report verifying that all design requirements are satisfied shall be prepared.**
- **Key manufacturing process controls in the form of a complete specification for materials and process controls shall be developed for the neutron absorber material by the supplier and approved by NAC to ensure that the product delivered for use is consistent with the qualified material in all respects that are important to the material's design function.**
- **Major changes in key manufacturing processes for neutron absorber material shall require a complete program of qualification testing prior to the use of the material produced by the changed process. Neutron absorber material process changes defined as major changes include those that: (1) reduce the neutron absorber material thermal conductivity; (2) increase the material porosity; (3) reduce the material strength; (4) increase the boron carbide content of the material; (5) change the matrix alloy; or (6) adversely affect the uniform distribution of the ^{10}B in the material.**
- **Minor neutron absorber material processing changes may be determined to be acceptable on the basis of engineering review without additional qualification testing, if such changes do not adversely affect the particle bonding microstructure, i.e., the durability or the uniformity of the boron carbide particle distribution, which is the neutron absorber effectiveness.**
- **Nonconforming material shall be evaluated for acceptance in accordance with the NAC International Quality Assurance Program.**

10.1.7 Thermal Tests

Thermal acceptance testing of the MAGNASTOR system following fabrication and construction is not required. Continued effectiveness of the heat-rejection capabilities of the system may be monitored during system operation using a remote temperature-monitoring system.

The heat-rejection system consists of convection air cooling where air flow is established and maintained by a chimney effect, with air moving from the lower inlets to the upper outlets. Since this system is passive, and air flow is established by the decay heat of the contents of the

TSC, it is sufficient to ensure by inspection that the inlet and outlet screens are clear and free of debris that could impede air flow. Because of the passive design of the heat-rejection system, no thermal testing is required.

10.1.8 Cask Identification

Each TSC and concrete cask shall be marked with a model number and an identification number. Each concrete cask will additionally be marked for empty weight and date of loading. Specific marking instructions are provided on the license drawings for these system components.

Chapter 11

11.3 Estimated Onsite Collective Dose Assessment

Operations personnel exposure estimates are based on identifying the operational cask sequence, estimating the duration and number of personnel required to perform the tasks, determining the location of the personnel in relation to the cask, and multiplying the dose rates at the particular task location by the number of personnel and the task duration. The operational tasks identified are based on the MAGNASTOR operating procedures provided in this document and operational experiences in loading other canister-based systems.

A collective dose estimate is provided for placing a single MAGNASTOR on the ISFSI, and for exposures related to routine storage operations of a 20-cask (2×10 array) ISFSI. Each cask in the array is assumed to be loaded with the contents that produce the maximum dose rate.

The personnel exposure estimates associated with loading and routine operations are presented in Table 11.3-1 through Table 11.3-4. The estimated durations, task sequences, and personnel requirements are based on the MAGNASTOR design features, operational experiences in loading systems of similar design, and operational and equipment improvements based on previous experience. These estimates are provided to allow the user to perform ALARA evaluations on MAGNASTOR implementation and use, and to establish personnel exposure guidelines for operating personnel. For each user, the site-specific design features, location and configuration of work stations, equipment staging, standard practices, operating crew size, use of temporary shielding, etc., will result in personnel exposures that may be higher or lower than those presented.

11.3.1 Estimated Dose Due to Loading Operations

The estimated dose due to loading operations considers the collective dose due to the loading, closure, transfer, and placement of a single TSC containing bounding fuel assembly contents. This analysis assumes that the exposure incurred by the operators is independent of background radiation, as background will vary with site conditions. A two mrem/hr dose rate is assigned to tasks not performed within four meters of the equipment or component surface. An example for these tasks is the monitoring of the operation of the welding system using cameras. This task may be performed at more than four meters from the cask body, and behind significant auxiliary shielding. The number of persons allocated to task completion is generally the minimum number of actual operators required for the task and excludes supervisory, health physics, security, and other nonoperating personnel.

Area dose rates are assigned based on the orientation of the worker(s) with respect to the source for a given operational task or sequence. Exposure estimates for the PWR and BWR systems are shown in Table 11.3-1 and Table 11.3-2. The number of individual tasks required for loading and transfer of the TSCs is collapsed to eight groups for this presentation. Dose rates shown are time-averaged values across the individual subtasks. Activities 7 and 8 of Table 11.3-1 and Table 11.3-2 include a crane operator who is considered to be outside of the radiation zone around the cask. Exposures due to loading operations are based on design basis casks conservatively loaded with 37 kW PWR and 35 kW BWR heat loads.

11.3.2 Estimated Dose Due to Routine Operations

Once the MAGNASTOR is in storage at the ISFSI, limited ongoing maintenance and surveillance will be required. The annual dose evaluations presented herein consider the tasks that are anticipated to be representative of an operational facility. Exposure due to certain events, such as clearing the material blocking the air vents, is taken into account.

Routine operations may include the following.

- An optional daily electronic measurement of ambient air and outlet air temperatures for each TSC in service. Outlet temperature measurements are recorded at a location away from the cask array, and operators are not expected to incur dose as a result of the temperature measurement.
- An optional inspection of the concrete cask inlet and outlet screens to verify that they are unobstructed. The time required to perform the inspection, and the expected dose, will be site-specific due to ISFSI pad dimensions and configurations, the concrete cask array, distance of the inspector, etc.
- A daily inspection of the security fence and equipment surrounding the ISFSI storage area. This surveillance is assumed to require 15 minutes and is performed by one security officer.
- Radiological surveillance. The surveillance consists of a radiological survey comprised of a surface radiation measurement on each cask, the determination and/or verification of general area exposure rates and radiological postings. This surveillance is assumed to require 30 minutes, and be performed quarterly by one health physics technician.
- Annual visual inspection of the general condition of the concrete casks. This inspection is estimated to require 10 minutes per cask and require one technician. For each cask, three minutes of health physics support is also included.
- Corrective maintenance. As the MAGNASTOR is a passively cooled and shielded system, no significant maintenance is expected over the lifetime of the IFSFI. To account for activities such as minor concrete repairs, air inlet and outlet cleaning, or temperature-monitoring equipment replacement, 10% of the array is assumed to require

maintenance each year. Maintenance exposure is evaluated based on two operators for 30 minutes each and one health physics technician for 10 minutes.

- Grounds maintenance performed twice a month by one maintenance technician. Grounds maintenance is assumed to require 60 minutes.

Storage operation exposures for a 2×10 array of either PWR or BWR concrete casks loaded with TSCs containing bounding fuel assembly sources are presented in Table 11.3-3 and Table 11.3-4. ISFSI exposures are based on design basis casks conservatively loaded with 40 kW PWR and 38 kW BWR heat loads.

Table 11.3-1 Estimated Person-mrem Exposure for Loading Operations of the PWR System

	Description	# of Subtasks	Exposure Duration (min)	Average Dose Rate (mrem/hr)	Exposure (mrem)
1	Fuel Assembly Loading and Transfer Cask Removal from Pool	4	908	2.7	83
2	HP Survey and Decon Top of TSC/Transfer Cask	3	30	26.0	13
3	Install Weld Shield/Weld Machine, and Perform Partial Drain of TSC	4	45	20.0	15
4	Perform Closure Lid and Ring Welding and PT Exams, Hydrostatically Test TSC	16	480	24.6	197
5	Drain TSC and Decontaminate Transfer Cask	5	230	32.3	124
6	Dry TSC Cavity, Backfill/Pressure TSC, Install Port Covers, Weld and Inspect Covers, Remove Weld Shield/Weld Machine, and Survey Cask/TSC Surfaces	13	475	7.2	57
7	Install Hoist Rings, Place Transfer Cask on Concrete Cask, Transfer TSC, Install Concrete Cask Lid, and Perform HP Survey	17	220	42.0	154
8	Move Concrete Cask to ISFSI, Position Concrete Cask on ISFSI Pad, and Install/Connect Screens and Temperature Measuring System	11	180	23.0	69
	Total				712

Chapter 12

12.1.2.3 Analysis of One-Half of the Air Inlets Blockage Event

Using the same methods and the same thermal models for the severe ambient temperature events, thermal evaluations are performed for the concrete cask and the TSC and its contents for the one-half air inlet blockage event. The boundary condition of the two-dimensional axisymmetric concrete cask and TSC model is modified to allow only one-half of the airflow into the air inlet to simulate the one-half of the air inlets blocked condition. The detailed analysis is provided in Section 4.5.

The calculated maximum component temperatures are compared to the allowable component temperatures. As shown, the calculated component temperatures are less than the component allowable temperatures.

Component	One-Half of Air Inlets Blocked Max Temperature (°F)		Allowable Temperature (°F)	
	PWR	BWR	PWR	BWR
Fuel Cladding	699	667	1058	1058
Fuel Basket	699	667	1000	1000
TSC Shell	457	431	800	800
Concrete	273	245	350	350

Note that the maximum fuel cladding temperatures are conservatively used as the maximum fuel basket temperatures.

The thermal stress evaluation for the concrete cask for the one-half of the air inlets blocked event is bounded by those for the accident event of "Maximum Anticipated Heat Load (133°F Ambient Temperature)" as reported in Section 12.2.7. Thermal stress analyses for the TSC and the basket components are performed using ANSYS finite element models as described in Section 3.6. For the TSC and baskets, bounding temperature gradients are used to bound the one-half of the air inlets blocked condition. A summary of thermal stresses is presented in Section 3.6

12.1.2.4 Corrective Actions

The debris blocking the air inlet screens will be manually removed. The nature of the debris may indicate that other actions are required to prevent recurrence of the blockage.

12.1.2.5 Radiological Impact

There are no significant radiological consequences for the one-half of the air inlets blocked event. Personnel will be subject to an estimated maximum contact dose rate of 448 mrem/hr when clearing the inlet screens of a concrete cask containing a conservative 37 kW payload of

PWR fuel. If it is assumed that a worker kneeling, with his hands at the inlet screens, would require 15 minutes to clear the screens, the estimated maximum extremity dose is 112 mrem. For clearing the inlet screens of a concrete cask containing a conservative 35 kW payload of BWR fuel, the maximum contact dose rate and the maximum extremity dose are estimated to be 364 mrem/hr and 91 mrem, respectively. The whole body dose in both the PWR and the BWR cases will be significantly less than the extremity doses.

12.1.3 Off-Normal TSC Handling Load

This section reports the results of the evaluation of the consequences of off-normal handling loads on the TSC during the installation of the TSC in the concrete cask, or removal of the TSC from the concrete cask or from the transfer cask. The TSC is handled vertically in the transfer cask.

12.1.3.1 Cause of Off-Normal TSC Handling Load Event

Unintended loads could be applied to the TSC due to misalignment or faulty crane operation, or inattention of the operators.

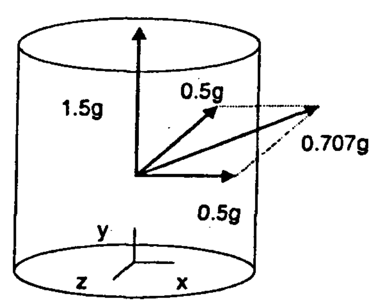
12.1.3.2 Detection of Off-Normal TSC Handling Load Event

The off-normal TSC-handling event can be detected visually during the handling of the TSC, or audibly by hearing a banging or scraping noise associated with TSC movement. The event is expected to be obvious to the operators at the time of occurrence.

12.1.3.3 Analysis of Off-Normal TSC Handling Load Event

The TSC off-normal handling analysis is performed using an ANSYS finite element model described in Chapter 3. The model is used to evaluate the TSCs for both PWR and BWR fuel types by modeling the longest TSC with the heaviest fuel/fuel basket weight. The material stress allowables used in the analysis consider the higher component temperatures that occur during transfer operations.

The off-normal TSC handling loads are defined as 0.5g applied in all directions (i.e., in the global x, y, and z directions) in addition to a 1g lifting load applied in the vertical direction. The resulting off-normal handling accelerations are 0.707g in the lateral direction and 1.5g (0.5g + 1g) in the vertical direction.



The resulting maximum TSC stresses for combined off-normal handling, maximum internal pressure and thermal stress loads are summarized in Section 3.6.

The structural evaluation of the PWR and BWR fuel basket tubes and support weldments for off-normal events is also presented in Section 3.6.

The TSCs and fuel baskets are shown to be structurally adequate for the off-normal handling condition. The minimum factors of safety for the TSC and the fuel basket are 1.28 and 1.07, respectively.

12.1.3.4 Corrective Actions

Operations should be halted until the cause of the misalignment, interference or faulty operation is identified and corrected. Since the radiation level of the TSC sides and bottom is high, extreme caution should be exercised if inspection of these surfaces is required.

12.1.3.5 Radiological Impact

There are no radiological consequences associated with this off-normal TSC handling event.

12.1.4 Failure of Instrumentation

MAGNASTOR may use a temperature-sensing system to measure the outlet air temperature at each of the four air outlets on each concrete cask. The air temperature at the outlets may be recorded and reviewed daily.

12.1.4.1 Cause of Instrumentation Failure Event

The temperature instrumentation failure event could occur as a result of instrumentation component failure, or as a result of any event that interrupted power or altered temperature sensor output.

12.1.4.2 Detection of Instrumentation Failure Event

The temperature instrumentation failure event may be identified by the lack of, or an inappropriate, reading at the temperature reader terminal. The event could also be identified by disparities between outlet temperatures in a cask or between similar casks.

12.1.4.3 Analysis of Instrumentation Failure Event

For concrete casks incorporating daily temperature-monitoring systems, the maximum time period during which an increase in the outlet air temperatures may go undetected is 24 hours. The principal condition that could cause an increase in temperature is the blockage of the air inlets. Section 12.2.13 shows that even if all of the air inlets of a single cask are blocked immediately after a temperature measurement, it would take longer than 24 hours before any

component approaches its allowable temperature limit. Therefore, there will be sufficient time to identify and correct temperature instrumentation failure events prior to critical system components reaching the temperature limits. During the period of loss of instrumentation, no significant change in TSC temperature will occur under normal conditions. Therefore, instrument failure would be of no consequence when the affected storage cask continues to operate in a normal storage condition.

Because the TSC and the concrete cask are a large heat sink, and because there are few conditions that could result in an outlet temperature increase, the temporary loss of the optional remote sensing and monitoring of the outlet air temperature is not a major concern. No applicable regulatory criteria are violated by the failure of the temperature instrumentation system.

12.1.4.4 Corrective Actions

This event requires that the temperature-monitoring equipment be either replaced or repaired or otherwise returned to operable, or that the concrete cask air inlet screens be visually inspected daily for blockage.

12.1.4.5 Radiological Impact

There are no radiological consequences for this event.

12.1.5 Small Release of Radioactive Particulate From the TSC Exterior

The procedures for loading the TSC provide for operations and measures to minimize TSC exterior surface contact with contaminated spent fuel pool water, and the TSC external surfaces are surveyed, to the extent practical, to verify removable contamination is within allowable limits. The external surfaces of the TSC are rolled or flat stainless steel plates, and the presence of excessive removable contamination on the external surfaces is unlikely. Therefore, radioactive particulate release from the TSC exterior surface is not expected to occur during normal storage operations.

12.1.5.1 Cause of Radioactive Particulate Release Event

The most likely cause of a radioactive particulate release event is air passing over the external surfaces of a contaminated TSC. In spite of precautions taken to preclude contamination of the external surface of the TSC, it is possible that a portion of the TSC surface may become contaminated during fuel loading by the spent fuel pool water and that the removable contamination in excess of allowable limits may go undetected. Subsequently, surface

contamination could become airborne and be released as a result of the airflow over the TSC surfaces.

12.1.5.2 Detection of Radioactive Particulate Release Event

The release of small amounts of radioactive contamination particulates over time is difficult to detect. Any release is likely to be too low to be detected by any of the normally employed long-term radiation dose monitoring methods (such as TLDs) normally located at the ISFSI perimeter fence. It is possible that a suspected release could be verified by a smear survey of the air outlets.

12.1.5.3 Analysis of Radioactive Particulate Release Event

The analysis presented in Section 5.6.5 calculates a total dose of less than 0.1 mrem at 100 meters from a design basis concrete cask based on removable contamination levels of 20,000 dpm/100 cm^2 β-γ and 200 dpm/100 cm^2 α.

The method for determining the dose is based on the plume dispersion calculations presented in U.S. NRC Regulatory Guides 1.109 [4] and 1.145 [5] and is highly conservative. The analysis demonstrates that the offsite radiological consequences from the release of TSC surface contamination is negligible, and all applicable regulatory criteria are met for an ISFSI array. ISFSI-specific allowable dose rates will be calculated on a site-specific basis to conform to 10 CFR 72.

12.1.5.4 Corrective Actions

No corrective action is required since the radiological consequence is negligible.

12.1.5.5 Radiological Impact

As previously shown, the potential offsite radiological impact due to the release of TSC surface contamination is negligible.

damage occurs, the concrete may be repairable by using grout. Otherwise, it may be necessary to remove the TSC, at the earliest possible time, for installation in an undamaged concrete cask.

If required, the storage pad should be repaired to preclude the intrusion of water that could cause further deterioration of the pad in freeze-thaw cycles.

12.2.12.6 Radiological Impact

There is a potential for an adverse radiological consequence in the hypothetical tip-over event, as the bottom end of the concrete cask and the TSC have significantly less shielding than in the radial direction. However, due to the small surface area exposed, relative to the size of the ISFSI, the dose rate at the site boundary will not exceed 5 rem/hour. Following a tip-over event, personnel access to the bottom area of the cask should be restricted, and supplemental shielding may be used until the concrete cask can be uprighted.

Damage to the edges or surface of the concrete cask may occur following a tip-over, which could result in a minor increase in localized dose rates.

12.2.13 Full Blockage of the Concrete Cask Air Inlets

This section presents the results of the evaluation of the concrete cask for the steady-state effects of full blockage of the air inlets at the normal ambient temperature (100°F). The evaluation estimates the duration of the event that would result in the fuel cladding, the fuel basket or the concrete cask components reaching their design basis limiting temperatures (see Chapter 4 for the allowable temperatures for accident conditions), or the TSC reaching its accident internal pressure limit. The evaluation demonstrates that there are no adverse consequences due to this accident, provided that blockage of the concrete cask air inlets is cleared within 58 hours.

12.2.13.1 Cause of Full Blockage

The likely cause of complete cask air inlet blockage is the covering of the base of the cask with snow, water, or earth in a catastrophic event that is significantly beyond the design basis earthquake or a landslide. This hypothetical event is a bounding accident and is not considered credible.

12.2.13.2 Detection of Full Blockage

Blockage of the cask air inlets will be visually detected during the general site inspection following an earthquake, landslide, or other events with a potential for such blockage. In addition, the cask inlets and outlets will be visually inspected to verify their unblocked

condition. or the concrete temperature differential measured every 24 hours, limiting the potential for a full blockage event to go undetected.

12.2.13.3 Analysis of Full Blockage

The evaluation of this event is presented in Section 4.6.3. The evaluation assumes initial normal storage conditions, with the sudden loss of convective cooling of the TSC in the concrete cask (simulating the full blockage of the air inlets and outlets). The loss of convective cooling results in the fairly rapid and sustained heat-up of the TSC and the concrete cask. Transient analysis is performed using the two-dimensional concrete cask and TSC thermal model. The spent fuel cladding, fuel basket and concrete cask component temperatures do not reach their accident condition limits for a time period of approximately 72 hours after initiation of the event. The TSC internal pressure will reach the analyzed maximum pressure in approximately 58 hours after a complete blockage occurs. The calculation of the maximum TSC internal pressure considers a helium temperature of 677°F and 100% failure of the fuel rods. Therefore, at least two of the air inlets are required to be cleared of blockage within 58 hours of the initiation of the event.

12.2.13.4 Corrective Actions

The obstruction(s) blocking two of the air inlets must be removed within 58 hours, and all blockage should be removed at the earliest possible date. The nature of the obstruction may indicate that other actions are required to prevent recurrence of the blockage.

12.2.13.5 Radiological Impact

There are no significant radiological consequences for this event, as the concrete cask retains its shielding performance. Dose to personnel may result from opening of the concrete cask, if access is required to clear the inlets of debris. The higher dose rates at the air inlets (448 mrem/hr for a 37 kW payload) will result in an increase in operator dose as a result of clearing the inlets. If it is assumed that a worker kneeling with his hands on the inlets requires 15 minutes to clear each inlet, the estimated extremity dose is a total of 448 mrem for clearing four air inlets. The whole body dose will be slightly less. In addition, some dose will be incurred clearing debris away from the concrete cask body. This dose is estimated at less than 50 mrem per cask, assuming one hour is spent near each concrete cask's exterior surface.

Chapter 13

Appendix A
Technical Specifications for the MAGNASTOR SYSTEM

Table of Contents

List of Tables

EXAMPLES

(continued)

EXAMPLE 1.4-2

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
Verify flow is within limit	Once within 12 hours prior to starting activity AND 24 hours thereafter

Example 1.4-2 has two Frequencies. The first is a one-time performance Frequency, and the second is of the type shown in Example 1.4-1. The logical connector "AND" indicates that both Frequency requirements must be met. Each time the example activity is to be performed, the Surveillance must be performed within 12 hours prior to starting the activity.

The use of "once" indicates a single performance will satisfy the specified Frequency (assuming no other Frequencies are connected by "AND"). This type of Frequency does not qualify for the 25% extension allowed by SR 3.0.2.

"Thereafter" indicates future performances must be established per SR 3.0.2, but only after a specified condition is first met (i.e., the "once" performance in this example). If the specified activity is canceled or not performed, the measurement of both intervals stops. New intervals start upon preparing to restart the specified activity.

2.0 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

MAGNASTOR contents shall be limited to the contents approved for storage by the NRC in Appendix B of these Technical Specifications and in Appendix 1-A of the FSAR, through the issuance of a cask Certificate of Compliance.

2.1.1 Fuel Parameters in Appendix B of the Technical Specifications

The fuel parameters listed in Appendix B of these Technical Specifications include the following:

Fissile Isotope
Fuel Class (e.g. 14×14, 15×15)
- Number of Fuel Rods
- Number of Guide Tubes (PWR)

Maximum Uranium Mass
Maximum Initial (Planar Average) Enrichment
Maximum Assembly Average Burnup
Minimum Cooling Time
Minimum Active Fuel Average Enrichment
Cladding Material
Nonfuel Hardware—e.g., BPRA/TPAs (cooling time and burnup)
Maximum Weight per Storage Location
Maximum Decay Heat per Storage Location
Fuel Condition
Number of Partial Length Fuel Rods

2.1.2 Fuel Parameters in Appendix 1-A of the FSAR

The fuel parameters listed in Appendix 1-A of the FSAR include the following:

Maximum Pitch
Minimum Cladding Outer Diameter
Minimum Cladding Thickness
Maximum Pellet Outer Diameter
Maximum Active Fuel Length
Subchannels (BWR)
Maximum Channel Thickness (BWR)

To change these parameters requires prior NRC approval. The process for requesting approval is described in Section 2.2.

(continued)

2.2 Proposed Changes to Appendix 1-A of the FSAR

Proposed changes to Appendix 1-A of the FSAR may be authorized by the Director of the Office of Nuclear Material Safety and Safeguards or designee. *The request for approval of such changes should demonstrate that:*

1. The proposed changes would provide an acceptable level of safety, and
2. The proposed changes are consistent with the applicable requirements.

Requests for changes to the parameters listed in Appendix 1-A shall be submitted in accordance with 10 CFR 72.4.

3.0 LIMITING CONDITION FOR OPERATION (LCO) APPLICABILITY

LCO 3.0.1	LCOs shall be met during specified conditions in the Applicability, except as provided in LCO 3.0.2.
LCO 3.0.2	Upon failure to meet an LCO, the Required Actions of the associated Conditions shall be met, except as provided in LCO 3.0.5. If the LCO is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the Required Action(s) is not required, unless otherwise stated
LCO 3.0.3	Not applicable to MAGNASTOR.
LCO 3.0.4	When an LCO is not met, entry into a specified condition in the Applicability shall not be made except when the associated ACTIONS to be entered permit continued operation in the specified condition in the Applicability for an unlimited period of time. This Specification shall not prevent changes in specified conditions in the Applicability that are required to comply with ACTIONS or that are related to the unloading of MAGNASTOR. Exceptions to this Condition are stated in the individual Specifications. These exceptions allow entry into specified conditions in the Applicability where the associated ACTIONS to be entered allow operation in the specified conditions in the Applicability only for a limited period of time.
LCO 3.0.5	This exception to LCO 3.0.2 is not applicable for the MAGNASTOR SYSTEM to return to service under administrative control to perform the testing.

3.0	SURVEILLANCE REQUIREMENT (SR) APPLICABILITY
SR 3.0.1	SRs shall be met during the specified conditions in the Applicability for individual LCOs, unless otherwise stated in the SR. Failure to meet Surveillance, whether such failure is experienced during the performance of the Surveillance or between performances of the Surveillance, shall be a failure to meet the LCO. Failure to perform Surveillance within the specified Frequency shall be a failure to meet the LCO, except as provided in SR 3.0.3. Surveillances do not have to be performed on equipment or variables outside specified limits.
SR 3.0.2	The specified Frequency for each SR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met. For Frequencies specified as "once," the above interval extension does not apply. If a Completion Time requires periodic performance on a "once per..." basis, the above Frequency extension applies to each performance after the initial performance. Exceptions to this Specification are stated in the individual Specifications.
SR 3.0.3	If it is discovered that Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the LCO not met may be delayed from the time of discovery up to 24 hours or up to the limit of the specified Frequency, whichever is less. This delay period is permitted to allow performance of the Surveillance. If the Surveillance is not performed within the delay period, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered. When the Surveillance is performed within the delay period and the Surveillance is not met, the LCO must immediately be declared not met, and the applicable Condition(s) must be entered.
SR 3.0.4	Entry into a specified Condition in the Applicability of an LCO shall not be made, unless the LCO's Surveillances have been met within their specified Frequency. This provision shall not prevent entry into specified conditions in the Applicability that are required to comply with Actions or that are related to the unloading of MAGNASTOR.

3.1 MAGNASTOR SYSTEM Integrity

3.1.1 Transportable Storage Canister (TSC)

LCO 3.1.1 The TSC shall be dry and helium filled.

APPLICABILITY: Prior to TRANSPORT OPERATIONS

ACTIONS

NOTE
Separate Condition entry is allowed for each TSC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. TSC cavity vacuum drying pressure or demoisturizer exit gas temperature limit not met.	A.1 Perform an engineering evaluation to determine the quantity of moisture remaining in the TSC. AND	7 days
	A.2 Develop and initiate corrective actions necessary to return the TSC to an analyzed condition.	30 days
B. TSC helium backfill density limit not met.	B.1 Perform an engineering evaluation to determine the effect of helium density differential. AND	72 hours
	B.2 Develop and initiate corrective actions necessary to return the TSC to an analyzed condition.	14 days
C. Required Actions and associated Completion Times not met.	C.1 Remove all fuel assemblies from the TSC.	30 days

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1.1	Verify TSC cavity vacuum drying pressure is less than or equal to 10 torr for greater than or equal to 10 minutes with the vacuum pump turned off and isolated. <u>OR</u> While recirculating helium through the TSC cavity, lower the gas dew point temperature exiting the TSC to ≤ 45°F, and verify that this temperature is within 1°F of the gas dew point temperature of the gas entering the TSC.	Once, prior to TRANSPORT OPERATIONS.
SR 3.1.1.2	Following vacuum drying and evacuation to < 3 torr, backfill the cavity with high purity helium until a mass M_{helium} corresponding to the free volume of the TSC measured during draining (V_{TSC}), multiplied by the helium density (L_{helium}) required for the design basis heat load and specified in Table 3-1, is reached. OR Following pressurized helium drying of the cavity, backfill the TSC with high purity helium to the density required for the design basis heat load and specified in Table 3-1 is reached.	Once, prior to TRANSPORT OPERATIONS.

Table 3-1 Helium Mass per Unit Volume for MAGNASTOR TSCs

Fuel Type	Helium Density (g/liter)
PWR	0.763
BWR	0.774

3.1 MAGNASTOR SYSTEM Integrity

3.1.2 CONCRETE CASK Heat Removal System

LCO 3.1.2 The CONCRETE CASK Heat Removal System shall be OPERABLE.

APPLICABILITY: During STORAGE OPERATIONS

ACTIONS

NOTE
Separate Condition entry is allowed for each MAGNASTOR SYSTEM.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. CONCRETE CASK Heat Removal System inoperable.	A.1 Ensure adequate heat removal to prevent exceeding short-term temperature limits.	Immediately
	<u>AND</u>	
	A.2 Restore CONCRETE CASK Heat Removal System to OPERABLE status.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.2.1	Verify that the difference between the average CONCRETE CASK air outlet temperature and ISFSI ambient temperature indicates that the CONCRETE CASK Heat Removal System is operable in accordance with the FSAR thermal evaluation.	24 hours
	<u>OR</u>	
	Visually verify all CONCRETE CASK air inlet and outlet screens are free of blockage.	24 hours

3.2 MAGNASTOR SYSTEM Criticality Control for PWR Fuel

3.2.1 Dissolved Boron Concentration

LCO 3.2.1 The dissolved boron concentration in the water in the TSC cavity shall be greater than, or equal to, the concentration specified in Appendix B, Table 2-3. A minimum concentration of 1,500 ppm is required for all PWR fuel types. Higher concentrations are required, depending on the fuel type and enrichment.

APPLICABILITY: During LOADING OPERATIONS and UNLOADING OPERATIONS with water and at least one fuel assembly in the TSC.

ACTIONS

NOTE

Separate Condition entry is allowed for each TSC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Dissolved boron concentration not met.	A.1 Suspend LOADING OPERATIONS or UNLOADING OPERATIONS	Immediately
	<u>AND</u>	
	A.2 Suspend positive reactivity additions.	Immediately
	<u>AND</u>	
	A.3 Initiate action to restore boron concentration to within limits.	Immediately

(continued)

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.2.1.1	Verify the dissolved boron concentration is met using two independent measurements.	Once within 4 hours prior to commencing LOADING OPERATIONS or UNLOADING OPERATIONS. <u>AND</u> Every 24 hours thereafter while the TSC is in the spent fuel pool or while water is in the TSC.

4.0 DESIGN FEATURES

4.1 Design Features Significant to Safety

4.1.1 Criticality Control

a) Minimum ^{10}B loading in the neutron absorber material:

Neutron Absorber Type	Required Minimum Effective Areal Density (^{10}B g/cm^2)		% Credit Used in Criticality Analyses	Required Minimum Actual Areal Density (^{10}B g/cm^2)	
	PWR Fuel	BWR Fuel		PWR Fuel	BWR Fuel
Borated Aluminum Alloy	0.036	0.027	90	0.04	0.03
Borated MMC	0.036	0.027	90	0.04	0.03
Boral	0.036	0.027	75	0.048	0.036

b) Acceptance and qualification testing of neutron absorber material shall be in accordance with Section 10.1.6.4.5 and Section 10.1.6.4.6. These sections of the FSAR are hereby incorporated into the MAGNASTOR CoC.

c) Soluble boron concentration in the PWR fuel pool and water in the TSC shall be in accordance with LCO 3.2.1, with a minimum water temperature 5-10°F higher than the minimum needed to ensure solubility.

4.1.2 Fuel Cladding Integrity

The licensee shall ensure that fuel oxidation and the resultant consequences are precluded during canister loading and unloading operations.

(continued)

4.2 Codes and Standards

The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), 2001 Edition with Addenda through 2003, Section III, Subsection NB, is the governing Code for the design, material procurement, fabrication, and testing of the TSC.

The ASME Code, 2001 Edition with Addenda through 2003, Section III, Subsection NG, is the governing Code for the design, material procurement, fabrication and testing of the spent fuel baskets.

The American Concrete Institute Specifications ACI-349 and ACI-318 govern the CONCRETE CASK design and construction, respectively.

The American National Standards Institute ANSI N14.6 (1993) and NUREG-0612 govern the TRANSFER CASK design, operation, fabrication, testing, inspection, and maintenance.

4.2.1 Alternatives to Codes, Standards, and Criteria

Table 2.1-2 of the FSAR lists approved alternatives to the ASME Code for the design, procurement, fabrication, inspection and testing of MAGNASTOR SYSTEM TSCs and spent fuel baskets.

4.2.2 Construction/Fabrication Alternatives to Codes, Standards, and Criteria

Proposed alternatives to ASME Code, Section III, 2001 Edition with Addenda through 2003, including alternatives authorized in Table 2.1-2 of the FSAR, may be used when authorized by the Director of the Office of Nuclear Material Safety and Safeguards or designee. The request for such alternatives should demonstrate that:

1. The proposed alternatives would provide an acceptable level of quality and safety, or
2. Compliance with the specified requirements of ASME Code, Section III, Subsections NB and NG, 2001 Edition with Addenda through 2003, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Requests for alternatives shall be submitted in accordance with 10 CFR 72.4.

(continued)

4.3 Site-Specific Parameters and Analyses

This section presents site-specific parameters and analytical bases that must be verified by the MAGNASTOR SYSTEM user. The parameters and bases presented in Section 4.3.1 are those applied in the design bases analysis.

4.3.1 Design Basis Specific Parameters and Analyses

The design basis site-specific parameters and analyses that require verification by the MAGNASTOR SYSTEM user are:

a. A temperature of 100°F is the maximum average yearly temperature. The three-day average ambient temperature shall be ≤106°F.

b. The allowed temperature extremes, averaged over a three-day period, shall be ≥–40°F and ≤133°F.

c. The analyzed flood condition of 15 fps water velocity and a depth of 50 ft of water (full submergence of the loaded cask) are not exceeded.

d. The potential for fire and explosion shall be addressed, based on site-specific considerations. This includes the condition that the fuel tank of the cask handling equipment used to move the loaded CONCRETE CASK onto or from the ISFSI site contains no more than 50 gallons of fuel.

e. In cases where engineered features (i.e., berms, shield walls) are used to ensure that requirements of 10 CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category on a site-specific basis.

f. The TRANSFER CASK shall not be operated and used when surrounding air temperature is < 0°F.

g. The CONCRETE CASK shall not be lifted by the lifting lugs with surrounding air temperatures < 0°F.

h. Loaded CONCRETE CASK lifting height limit ≤24 inches.

(continued)

4.4 TSC Handling and Transfer Facility

The TSC provides a leaktight confinement boundary and is evaluated for normal and off-normal handling loads. A handling and transfer facility is not required for TSC and TRANSFER CASK handling and transfer operations within a 10 CFR 50 licensed facility.

Movements of the TRANSFER CASK and TSC outside of a 10 CFR 50 licensed facility are not permitted unless a TSC TRANSFER FACILITY is designed, operated, fabricated, tested, inspected, and maintained in accordance with the following requirements. These requirements do not apply to handling heavy loads under a 10 CFR 50 license.

The permanent or stationary weldment structure of the TSC TRANSFER FACILITY shall be designed to comply with the stress limits of ASME Code, Section III, Subsection NF, Class 3 for linear structures. All compression loaded members shall satisfy the buckling criteria of ASME Code, Section III, Subsection NF.

The reinforced concrete structure of the facility shall be designed in accordance with ACI-349 and the factored load combinations set forth in ACI-318 for the loads defined in Table 4-1 shall apply. TRANSFER CASK and TSC lifting devices installed in the handling facility shall be designed, fabricated, operated, tested, inspected, and maintained in accordance with NUREG-0612, Section 5.1.

If mobile load lifting and handling equipment is used at the facility, that equipment shall meet the guidelines of NUREG-0612, Section 5.1, with the following conditions:

a. The mobile lifting device (i.e., crane) shall have a minimum safety factor of two over the allowable load table for the lifting device in accordance with the guidance of NUREG-0612, Section 5.1.6 (1)(a), and shall be capable of stopping and holding the load during a design earthquake event;

b. The mobile lifting device shall contain ≤50 gallons of flammable liquid during operation inside the ISFSI;

c. Mobile cranes are not required to meet the guidance of NUREG-0612, Section 5.1.6(2) for new cranes;

d. The mobile lifting device shall conform to the requirements of ASME B30.5, "Mobile and Locomotive Cranes";

e. Movement of the TSC or CONCRETE CASK in a horizontal orientation is not permitted.

Table 4-1 Load Combinations and Service Condition Definitions for the TSC Handling and Transfer Facility Structure

Load Combination	ASME Section III Service Condition for Definition of Allowable Stress	Note
D* D + S	Level A	All primary load bearing members must satisfy Level A stress limits
D + M + W'[1] D + F D + E D + Y	Level D	Factor of safety against overturning shall be ≥ 1.1, if applicable.

D	=	Crane hook dead load
D*	=	Apparent crane hook dead load
S	=	Snow and ice load for the facility site
M	=	Tornado missile load of the facility site[1]
W'	=	Tornado wind load for the facility site[1]
F	=	Flood load for the facility site
E	=	Seismic load for the facility site
Y	=	Tsunami load for the facility site

1. Tornado missile load may be reduced or eliminated based on a Probabilistic Risk Assessment for the facility site.

5.0 ADMINISTRATIVE CONTROLS AND PROGRAMS

5.1 Administrative Programs

The following programs shall be established, implemented, and maintained:

5.1.1 Radioactive Effluent Control Program

A program shall be established and maintained to:

1. Implement the requirements of 10 CFR 72.44 (d) or 10 CFR 72.126, as appropriate.
2. Provide limits on the surface contamination of the TSC and TRANSFER CASK, and verification of meeting those limits prior to removal of the loaded TSC and/or TRANSFER CASK from the 10 CFR 50 structure.
3. Provide an effluent monitoring program, as appropriate, if surface contamination limits are greater than the values specified in Regulatory Guide 1.86.

5.1.2 TSC Loading, Unloading, and Preparation Program

A program shall be established and maintained to implement the FSAR, Chapter 9 requirements for loading fuel and components into the TSC, unloading fuel and components from the TSC, and preparing the TSC and CONCRETE CASK for storage. The requirements of the program for loading and preparing the TSC shall be completed prior to removing the TSC from the 10 CFR 50 structure. The program shall provide for evaluation and control of the following FSAR requirements during the applicable operation:

- Verify that no TRANSFER CASK handling or CONCRETE CASK handling using the lifting lugs occurs when the ambient temperature is < 0°F.
- The water temperature of a water-filled, or partially filled, loaded TSC shall be shown by analysis and/or measurement to be less than boiling at all times.
- Verify that the drying time, cavity vacuum pressure, and component and gas temperatures ensure that the fuel cladding temperature limit of 400°C is not exceeded during TSC preparation activities, and that the TSC is adequately dry.
- Verify that the helium backfill purity and mass assure adequate heat transfer and preclude fuel cladding corrosion.
- The inner port cover welds to the closure lid at the vent port and at the drain port shall be qualified in accordance with the procedures in Section 9.1.1.

continued

- Verify that the time to complete the transfer of the TSC from the TRANSFER CASK to the CONCRETE CASK and from a CONCRETE CASK to another CONCRETE CASK assures that the fuel cladding temperature limit of 400°C is not exceeded.
- The surface dose rates of the CONCRETE CASK are adequate to allow proper storage and to assure consistency with the offsite dose analysis.
- The equipment used to move the loaded CONCRETE CASK onto or from the ISFSI site contains no more than 50 gallons of flammable liquid.

This program will control limits, surveillances, compensatory measures and appropriate completion times to assure the integrity of the fuel cladding at all times in preparation for and during LOADING OPERATIONS, UNLOADING OPERATIONS, TRANSPORT OPERATIONS, TRANSFER OPERATIONS and STORAGE OPERATIONS, as applicable.

5.1.3 Transport Evaluation Program

A program that provides a means for evaluating transport route conditions shall be developed to ensure that the design basis impact g-load drop limits are met. For lifting of the loaded TRANSFER CASK or CONCRETE CASK using devices that are integral to a structure governed by 10 CFR 50 regulations, 10 CFR 50 requirements apply. This program evaluates the site-specific transport route conditions and controls, including the transport route road surface conditions; road and route hazards; security during transport; ambient temperature; and equipment operability and lift heights. The program shall also consider drop event impact g-loading and route subsurface conditions, as necessary.

5.1.4 ISFSI Operations Program

A program shall be established to implement FSAR requirements for ISFSI operations.

At a minimum, the program shall include the following criteria to be verified and controlled:

a. Minimum CONCRETE CASK center-to-center spacing.

b. ISFSI pad parameters (i.e., thickness, concrete strength, soil modulus, reinforcement, etc.) are consistent with the FSAR analyses.

c. Maximum CONCRETE CASK lift heights ensure that the g-load limits analyzed in the FSAR are not exceeded.

Appendix B
Approved Contents for the MAGNASTOR System

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1.0 FUEL SPECIFICATIONS AND LOADING CONDITIONS

MAGNASTOR is designed to provide passive dry storage of canistered PWR and BWR fuel. The system requires few operating controls. The principal controls and limits for MAGNASTOR are satisfied by the selection of fuel for storage that meets the Approved Contents presented in this section and in the tables for MAGNASTOR design basis spent fuels.

If any Fuel Specification or Loading Condition of this section is violated, the following actions shall be completed:

- The affected fuel assemblies shall be placed in a safe condition.
- Within 24 hours, notify the NRC Operations Center.
- Within 60 days, submit a special report that describes the cause of the violation and actions taken to restore or demonstrate compliance and prevent reoccurence.

2.0 FUEL TO BE STORED IN THE MAGNASTOR SYSTEM

INTACT FUEL ASSEMBLIES meeting the limits specified in Tables 2-1 through 2-17 and Tables 6.4-1 and 6.4-2 of the FSAR may be stored in the MAGNASTOR SYSTEM.

Table 2-1 PWR Fuel Assembly Limits

I. PWR Fuel

A. Allowable Contents

1. Uranium PWR INTACT FUEL ASSEMBLIES listed in Tables 2-2 and 2-3 and meeting the following specifications:

a. Cladding Type:	Zirconium-based alloy.
b. Enrichment, Post-irradiation Cooling Time and Average Assembly Burnup:	Generic maximum enrichment limits are shown in Table 2-2. Fuel type specific maximum enrichments at various minimum soluble boron levels are defined in Table 2-3. For variable enrichment fuel assemblies, maximum enrichments represent peak rod enrichments. Combined minimum enrichment, maximum assembly average burnup and minimum cool time limits are shown in Tables 2-13 through 2-16. For assembly average burnup levels below those shown in Tables 2-13 through 2-16, an assembly minimum cool time is specified in Table 2-11, provided that the minimum initial assembly average enrichment limits are applied.
c. Decay Heat Per Assembly:	≤ 1,200 watts
d. Nominal Fresh Fuel Assembly Length (in.):	≤ 178.3
e. Nominal Fresh Fuel Assembly Width (in.):	≤ 8.54
f. Fuel Assembly Weight (lbs.):	≤1,680, including nonfuel-bearing components

B. Quantity per TSC: Up to 37 PWR INTACT FUEL ASSEMBLIES. Fuel storage locations not containing a fuel assembly shall have an empty fuel cell insert installed.

C. PWR INTACT Fuel Assemblies may contain a flow mixer (thimble plug), a burnable poison rod assembly, or a control element assembly consistent with Table 2-2. Assemblies may contain solid filler rods that displace a volume equal to, or greater than, that of the original fuel rod. Assemblies may have stainless steel rods inserted to displace guide tube "dashpot" water. Loading activated nonfuel hardware requires extended fuel assembly cool times, and Table 2-4 presents the additional fuel assembly cool times required. Minimum BPRA and thimble plug cool times as a function of burnup (exposure) are shown in Tables 2-5 and 2-6. Alternatively, the ^{60}Co curie limits in Tables 2-5 and 2-6 may be used to establish site-specific nonfuel hardware constraints.

Table 2-1 PWR Fuel Assembly Limits (continued)

D. Spacers may be used in a TSC to axially position fuel assemblies to facilitate handling.

E. Unenriched fuel assemblies are not authorized for loading. Unenriched axial blankets are permitted.

F. Fuel may be loaded uniformly at a maximum heat load of 959 watts/assembly. Alternatively, a preferential loading pattern may be applied as described in Table 2-7 and Figure 2-1.

G. CEAs are restricted to the center 9 basket locations. Minimum CEA cool time is 10 years with a maximum equivalent exposure of 180,000 MWd/MTU.

Table 2-2 PWR Fuel Assembly Characteristics

Characteristic	14×14	14×14	15×15	15×15	16×16	17×17
Max Initial Enrichment (wt % ^{235}U)	5.0	5.0	5.0	5.0	5.0	5.0
Min Initial Enrichment (wt % ^{235}U)	1.3	1.3	1.3	1.3	1.3	1.3
Number of Fuel Rods	176	179	204	208	236	264
Max Assembly Average Burnup (MWd/MTU)	60,000	60,000	60,000	60,000	60,000	60,000
Peak Average Rod Burnup (MWd/MTU)	62,500	62,500	62,500	62,500	62,500	62,500
Min Cool Time (years)	4	4	4	4	4	4
Max Weight (lb) per Storage Location	1,680	1,680	1,680	1,680	1,680	1,680
Max Decay Heat (Watts) per Preferential Storage Location	1,200	1,200	1,200	1,200	1,200	1,200

- All reported enrichment values are nominal preirradiation fabrication values.
- Maximum initial enrichment is based on a minimum soluble boron concentration in the spent fuel pool water. Required soluble boron content is fuel type and enrichment specific. Minimum soluble boron content varies between 1,500 and 2,500 ppm. Maximum initial enrichment represents the peak fuel rod enrichment for variably-enriched fuel assemblies.
- Maximum uniform heat load is 959 watts per storage location.

Table 2-3 Bounding PWR Fuel Assembly Loading Criteria

Assembly Type	No. of Fuel Rods	No. of Guide Tubes[a]	Max Load (MTU)	Max. Initial Enrichment (wt% ^{235}U) Min Soluble Boron 1500 ppm	Min Soluble Boron 1750 ppm	Min Soluble Boron 2000 ppm	Min Soluble Boron 2250 pm	Min Soluble Boron 2500 ppm
BW15H1	208	17	0.4858	3.8%	4.1%	4.4%	4.7%	5.0%
BW15H2	208	17	0.4988	3.7%	4.1%	4.4%	4.7%	5.0%
BW15H3	208	17	0.5006	3.7%	4.0%	4.3%	4.7%	4.9%
BW15H4	208	17	0.4690	3.9%	4.2%	4.6%	4.9%	5.0%
BW17H1	264	25	0.4799	3.8%	4.1%	4.4%	4.7%	5.0%
CE14H1	176	5	0.4167	4.6%	4.9%	5.0%	5.0%	5.0%
CE16H1	236	5	0.4463	4.5%	4.9%	5.0%	5.0%	5.0%
WE14H1	179	17	0.4188	4.7%	5.0%	5.0%	5.0%	5.0%
WE15H1	204	21	0.4720	3.9%	4.2%	4.6%	4.9%	5.0%
WE15H2	204	21	0.4469	4.0%	4.4%	4.8%	5.0%	5.0%
WE17H1	264	25	0.4740	3.8%	4.1%	4.5%	4.8%	5.0%
WE17H2	264	25	0.4327	4.0%	4.4%	4.8%	5.0%	5.0%

Notes: Specified soluble boron concentrations are independent of whether an assembly contains a nonfuel insert.
Specific fuel characteristics are defined in Table 6.4-1 of the FSAR.

Table 2-4 Additional Fuel Assembly Cool Time Required to Load PWR Nonfuel Hardware

Core (Assembly)	Cool Time (years) BPRA	TP	CEA
CE 14×14	--	--	0.1
WE 14×14	0.5	0.1	0.5
WE 15×15	0.5	0.1	0.7
B&W 15×15	0.1	0.1	0.1
CE 16×16	--	--	0.1
WE 17×17	0.5	0.1	0.7
B&W 17×17	0.1	0.1	0.1

Note: Additional fuel assembly cooling time to be added to the minimum fuel assembly cool time based on assembly initial enrichment and assembly average burnup listed in Table 2-13 through Table 2-16.

[a] *Combined number of guide and instrument tubes.*

Table 2-5 Allowed BPRA Burnup and Cool Time Combinations

Maximum Burnup (GWd/MTU)	Minimum Cool Time (yrs)				
	WE 14×14	WE 15×15	B&W 15×15	WE 17×17	B&W 17×17
10	0.5	0.5	0.5	0.5	0.5
15	0.5	0.5	0.5	0.5	0.5
20	0.5	1.0	2.0	2.0	0.5
25	1.0	2.5	3.5	3.5	1.0
30	2.5	4.0	5.0	5.0	2.5
32.5	3.0	4.5	6.0	6.0	3.0
35	3.5	5.0	6.0	6.0	3.5
37.5	4.0	6.0	7.0	7.0	4.0
40	4.5	6.0	7.0	7.0	4.5
45	5.0	7.0	8.0	8.0	6.0
50	6.0	8.0	9.0	9.0	7.0
55	7.0	8.0	10.0	9.0	7.0
60	7.0	9.0	10.0	10.0	8.0
65	8.0	10.0	12.0	12.0	8.0
70	8.0	10.0	12.0	12.0	9.0
Max ^{60}Co Activity (Ci)	718	733	19	637	26

Note: Specified minimum cool times for BPRAs are independent of the required minimum cool times for the fuel assembly containing the BPRA.

Table 2-6 Allowed Thimble Plug Burnup and Cool Time Combinations

Maximum Burnup (GWd/MTU)	Minimum Cool Time (yrs)				
	WE 14×14	WE 15×15	B&W 15×15	WE 17×17	B&W 17×17
45	2.0	3.5	7.0	5.0	6.0
90	6.0	7.0	10.0	9.0	10.0
135	7.0	9.0	12.0	10.0	12.0
180	8.0	9.0	14.0	12.0	12.0
^{60}Co Activity (Ci)	63.5	64.1	56.9	64.0	63.6

Note: Specified minimum cool times for thimble plugs are independent of the required minimum cool times for the fuel assembly containing the thimble plug.

Table 2-7 PWR Fuel Preferential Loading Pattern Definition

Zone Description (see Figure 2-1)	Designator	Maximum Heat Load (W/assy)	# Assemblies
Inner Zone	A	922	9
Middle Zone	B	1,200	12
Outer Zone	C	800	16

Figure 2-1 Schematic of PWR Fuel Preferential Loading Pattern

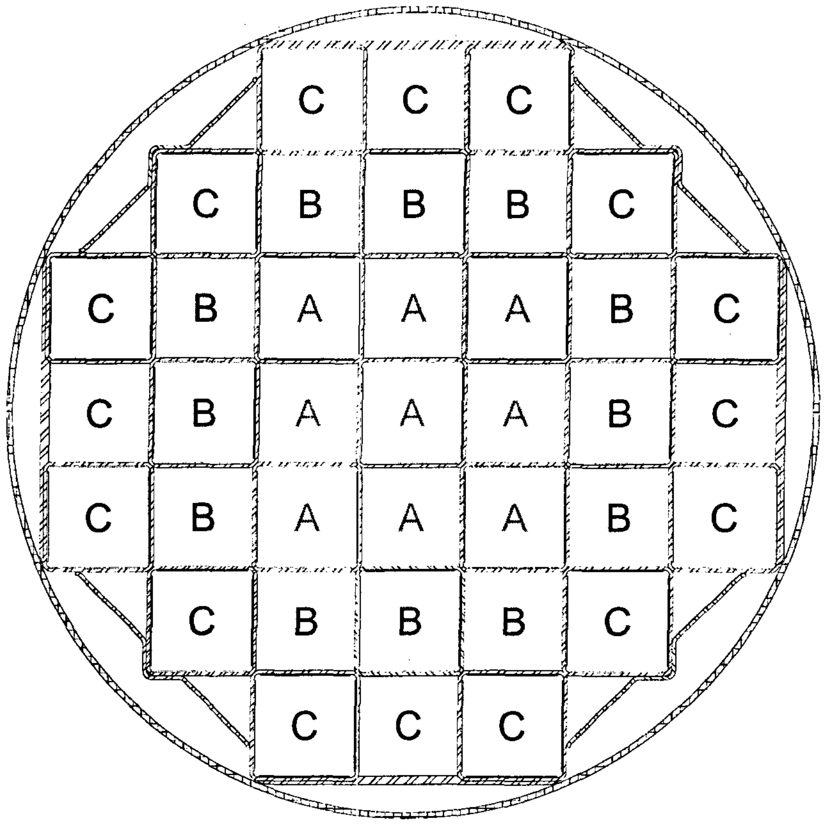


Table 2-8 BWR Fuel Assembly Limits

I. BWR FUEL

A. Allowable Contents

1. Uranium BWR INTACT FUEL ASSEMBLIES listed in Tables 2-9 and 2-10 and meeting the following specifications:

a. Cladding Type:	Zirconium-based alloy.
b. Enrichment: Post-irradiation Cooling Time and Assembly Average Burnup	Generic maximum INITIAL PEAK PLANAR-AVERAGE ENRICHMENTS are shown in Table 2-9. Fuel type specific enrichment limits for the 87-assembly and 82-assembly BWR fuel basket configurations are defined in Table 2-10. Combined minimum enrichment, maximum assembly average burnup and minimum cool time limits are shown in Table 2-17. For assembly average burnup levels below those shown in Table 2-17, an assembly minimum cool time is specified in Table 2-12, provided that the minimum initial assembly average enrichment limits are applied.
c. Decay Heat per Assembly:	≤ 379 watts
d. Nominal Fresh Fuel Design Assembly Length (in.):	≤ 176.2
e. Nominal Fresh Fuel Design Assembly Width (in.):	≤ 5.52
f. Fuel Assembly Weight (lb):	≤ 704, including channels

B. Quantity per TSC: Up to 87 BWR INTACT FUEL ASSEMBLIES. Fuel storage locations not containing a fuel assembly shall have an empty fuel cell insert installed.

C. BWR fuel assemblies may be unchanneled, or channeled with zirconium-based alloy channels.

D. BWR fuel assemblies with stainless steel channels are not authorized.

E. Spacers may be used in a TSC to axially position BWR fuel assemblies to facilitate handling.

F. Unenriched fuel assemblies are not authorized for loading. Unenriched axial blankets are permitted.

G. Allowable fuel assembly locations for the 82-assembly fuel basket configuration are shown in Figure 2-2.

Table 2-9 BWR Fuel Assembly Characteristics

Characteristic	Fuel Class 7×7	8×8	9×9	10×10
Max Initial Enrichment (wt % ^{235}U)	4.5	4.5	4.5	4.5
Number of Fuel Rods	48/49	59/60/61/ 62/63/64	72/74[a]/76 / 79/80	91[a]/92[a]/ 96[a]/100
Max Assembly Average Burnup (MWD/MTU)	60,000	60,000	60,000	60,000
Peak Average Rod Burnup (MWd/MTU)	62,500	62,500	62,500	62,500
Min Cool Time (years)	4	4	4	4
Min Average Enrichment (wt % ^{235}U)	1.3	1.3	1.3	1.3
Max Weight (lb) per Storage Location	704	704	704	704
Max Decay Heat (Watts) per Storage Location	379	379	379	379

- Each BWR fuel assembly may include a zirconium-based alloy channel up to a nominal channel thickness of 120 mil.
- Assembly weight includes the weight of the channel.
- Maximum initial enrichment is the peak planar-average enrichment.
- Water rods may occupy more than one fuel lattice location. Fuel assembly to contain nominal number of water rods for the specific assembly design.
- All enrichment values are nominal preirradiation fabrication values.
- Spacers may be used to axially position fuel assemblies to facilitate handling.

[a] Assemblies may contain partial-length fuel rods.

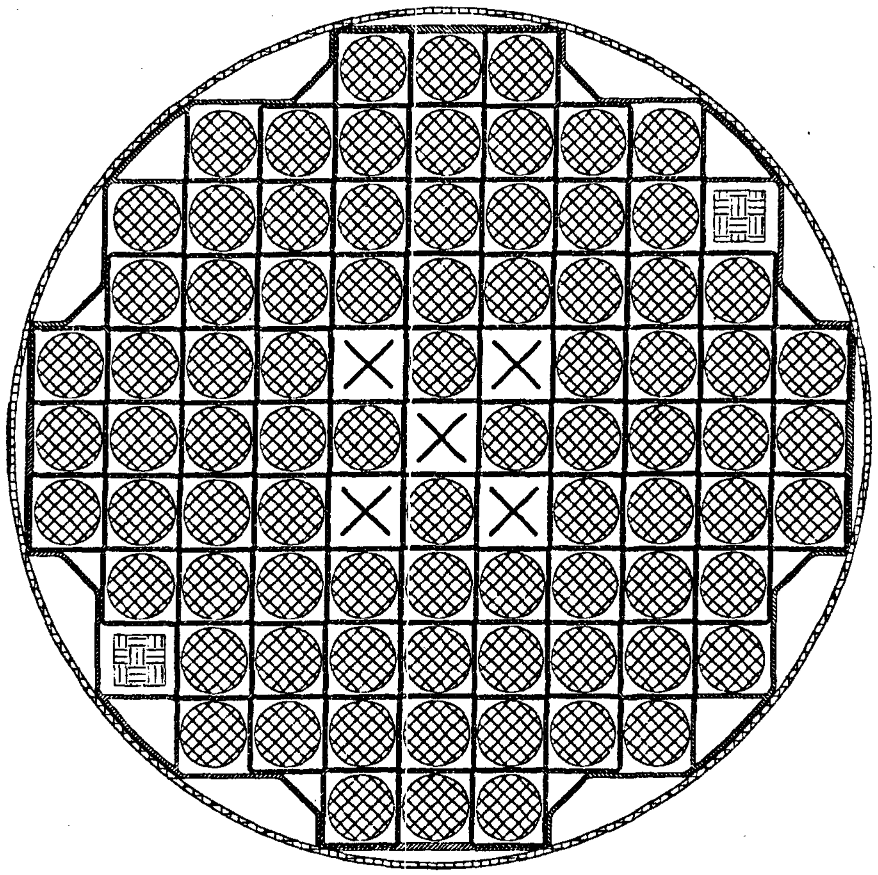
Table 2-10 BWR Fuel Assembly Loading Criteria

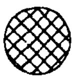
Assembly Type	Number of Fuel Rods	Number of Partial Length Rods[a]	Max Loading (MTU)	87-Assy. Max Enrichment (wt% ^{235}U)	82-Assy Max Enrichment (wt% ^{235}U)
B7_48A	48	N/A	0.1981	4.1%	4.5%
B7_49A	49	N/A	0.2034	3.9%	4.5%
B7_49B	49	N/A	0.2115	3.9%	4.5%
B8_59A	59	N/A	0.1828	4.0%	4.5%
B8_60A	60	N/A	0.1815	3.9%	4.5%
B8_60B	60	N/A	0.1841	3.9%	4.5%
B8_61B	61	N/A	0.1872	3.9%	4.5%
B8_62A	62	N/A	0.1921	3.9%	4.5%
B8_63A	63	N/A	0.1985	3.8%	4.5%
B8_64A	64	N/A	0.2017	3.9%	4.5%
B8_64B	64	N/A	0.1755	3.7%	4.4%
B9_72A	72	N/A	0.1803	3.8%	4.5%
B9_74A	74[b]	8	0.1873	3.7%	4.4%
B9_76A	76	N/A	0.1914	3.6%	4.3%
B9_79A	79	N/A	0.2000	3.7%	4.5%
B9_80A	80	N/A	0.1821	3.9%	4.5%
B10_91A	91[b]	8	0.1906	3.8%	4.5%
B10_92A	92[b]	14	0.1966	3.8%	4.5%
B10_96A	96[b]	12	0.1787	3.7%	4.4%
B10_100A	100	N/A	0.1861	3.7%	4.5%

Note: Specific fuel characteristics are defined in Table 6.4-2 of the FSAR.

[a] Location of the partial length rods is illustrated in Figure 6.2-1 of the FSAR.
[b] Assemblies may contain partial-length fuel rods.

Figure 2-2 82-Assembly BWR Basket Pattern



 = Fuel Assembly Locations

 = Vent/Drain Port Locations

 = Designated Nonfuel Locations

Table 2-11 PWR Loading Table – Low Assembly Average Burnup Enrichment Limits

Max. Assembly Avg. Burnup (MWd/MTU)	Min. Assembly Avg. Initial Enrichment (wt% ^{235}U)	Minimum Cool Time (yrs)			
Heat Load per Assy	--	959 W	800 W	922 W	1,200 W
10,000	1.3	4.0	4.0	4.0	4.0
15,000	1.5	4.0	4.0	4.0	4.0
20,000	1.7	4.0	4.0	4.0	4.0
25,000	1.9	4.0	4.3	4.0	4.0
30,000	2.1	4.4	5.2	4.5	4.0

Table 2-12 BWR Loading Table – Low Assembly Average Burnup Enrichment Limits

Max. Assembly Avg. Burnup (MWd/MTU)	Min. Assembly Avg. Initial Enrichment (wt% ^{235}U)	Minimum Cool Time (yrs)
10,000	1.3	4.0
15,000	1.5	4.0
20,000	1.7	4.0
25,000	1.9	4.0
30,000	2.1	4.3

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.1	4.1	4.6	4.7	4.4	4.7	4.7
2.3 ≤ E < 2.5	4.0	4.1	4.5	4.7	4.4	4.6	4.6
2.5 ≤ E < 2.7	4.0	4.0	4.5	4.6	4.3	4.6	4.6
2.7 ≤ E < 2.9	4.0	4.0	4.5	4.5	4.3	4.5	4.5
2.9 ≤ E < 3.1	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.1 ≤ E < 3.3	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.3 ≤ E < 3.5	4.0	4.0	4.3	4.4	4.2	4.4	4.4
3.5 ≤ E < 3.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
3.7 ≤ E < 3.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
3.9 ≤ E < 4.1	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.1 ≤ E < 4.3	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.3 ≤ E < 4.5	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.5 ≤ E < 4.7	4.0	4.0	4.1	4.2	4.0	4.2	4.2
4.7 ≤ E < 4.9	4.0	4.0	4.1	4.2	4.0	4.2	4.2
E ≥ 4.9	4.0	4.0	4.1	4.2	4.0	4.2	4.2
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.3	4.4	5.0	5.1	4.7	5.0	5.0
2.5 ≤ E < 2.7	4.3	4.4	4.9	5.0	4.7	5.0	5.0
2.7 ≤ E < 2.9	4.2	4.3	4.8	5.0	4.6	4.9	4.9
2.9 ≤ E < 3.1	4.2	4.3	4.8	4.9	4.6	4.9	4.9
3.1 ≤ E < 3.3	4.1	4.2	4.7	4.9	4.5	4.8	4.8
3.3 ≤ E < 3.5	4.1	4.2	4.7	4.8	4.5	4.8	4.8
3.5 ≤ E < 3.7	4.1	4.1	4.6	4.8	4.4	4.7	4.7
3.7 ≤ E < 3.9	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.9 ≤ E < 4.1	4.0	4.1	4.6	4.7	4.4	4.7	4.7
4.1 ≤ E < 4.3	4.0	4.0	4.5	4.7	4.3	4.6	4.6
4.3 ≤ E < 4.5	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.5 ≤ E < 4.7	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.7 ≤ E < 4.9	4.0	4.0	4.4	4.6	4.3	4.5	4.5
E ≥ 4.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.7	4.8	5.5	5.7	5.2	5.6	5.6
2.5 ≤ E < 2.7	4.6	4.7	5.4	5.6	5.1	5.5	5.5
2.7 ≤ E < 2.9	4.6	4.7	5.3	5.5	5.0	5.4	5.4
2.9 ≤ E < 3.1	4.5	4.6	5.3	5.4	5.0	5.4	5.4
3.1 ≤ E < 3.3	4.5	4.5	5.2	5.4	4.9	5.3	5.3
3.3 ≤ E < 3.5	4.4	4.5	5.1	5.3	4.9	5.2	5.2
3.5 ≤ E < 3.7	4.4	4.5	5.0	5.2	4.8	5.2	5.2
3.7 ≤ E < 3.9	4.3	4.4	5.0	5.2	4.8	5.1	5.1
3.9 ≤ E < 4.1	4.3	4.4	5.0	5.1	4.7	5.1	5.1
4.1 ≤ E < 4.3	4.3	4.4	4.9	5.1	4.7	5.0	5.0
4.3 ≤ E < 4.5	4.2	4.3	4.9	5.0	4.7	5.0	5.0
4.5 ≤ E < 4.7	4.2	4.3	4.9	5.0	4.6	5.0	5.0
4.7 ≤ E < 4.9	4.2	4.3	4.8	5.0	4.6	4.9	4.9
E ≥ 4.9	4.1	4.2	4.8	4.9	4.5	4.9	4.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.0	5.2	5.9	6.1	5.6	6.0	6.0
2.7 ≤ E < 2.9	5.0	5.1	5.9	6.0	5.5	5.9	5.9
2.9 ≤ E < 3.1	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.1 ≤ E < 3.3	4.9	4.9	5.7	5.9	5.4	5.8	5.8
3.3 ≤ E < 3.5	4.8	4.9	5.7	5.8	5.3	5.7	5.7
3.5 ≤ E < 3.7	4.7	4.8	5.6	5.8	5.2	5.7	5.7
3.7 ≤ E < 3.9	4.7	4.8	5.5	5.7	5.2	5.6	5.6
3.9 ≤ E < 4.1	4.6	4.8	5.5	5.7	5.1	5.6	5.6
4.1 ≤ E < 4.3	4.6	4.7	5.4	5.6	5.1	5.5	5.5
4.3 ≤ E < 4.5	4.5	4.7	5.4	5.6	5.0	5.5	5.5
4.5 ≤ E < 4.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
4.7 ≤ E < 4.9	4.5	4.6	5.3	5.5	5.0	5.4	5.4
E ≥ 4.9	4.5	4.5	5.2	5.4	4.9	5.4	5.4

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.3	5.4	6.2	6.4	5.8	6.3	6.3
2.7 ≤ E < 2.9	5.2	5.3	6.1	6.3	5.7	6.2	6.2
2.9 ≤ E < 3.1	5.1	5.2	6.0	6.2	5.7	6.1	6.1
3.1 ≤ E < 3.3	5.0	5.1	5.9	6.1	5.6	6.0	6.0
3.3 ≤ E < 3.5	4.9	5.1	5.9	6.0	5.5	5.9	5.9
3.5 ≤ E < 3.7	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.7 ≤ E < 3.9	4.8	4.9	5.7	5.9	5.4	5.8	5.8
3.9 ≤ E < 4.1	4.8	4.9	5.7	5.9	5.3	5.8	5.8
4.1 ≤ E < 4.3	4.7	4.9	5.6	5.8	5.3	5.7	5.7
4.3 ≤ E < 4.5	4.7	4.8	5.6	5.8	5.2	5.7	5.7
4.5 ≤ E < 4.7	4.7	4.8	5.5	5.7	5.2	5.6	5.6
4.7 ≤ E < 4.9	4.6	4.7	5.5	5.7	5.1	5.6	5.6
E ≥ 4.9	4.6	4.7	5.5	5.6	5.1	5.6	5.6
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.5	5.6	6.5	6.7	6.0	6.6	6.6
2.7 ≤ E < 2.9	5.4	5.5	6.4	6.6	5.9	6.5	6.5
2.9 ≤ E < 3.1	5.3	5.4	6.3	6.5	5.9	6.4	6.4
3.1 ≤ E < 3.3	5.2	5.3	6.2	6.4	5.8	6.3	6.3
3.3 ≤ E < 3.5	5.1	5.3	6.1	6.3	5.7	6.2	6.2
3.5 ≤ E < 3.7	5.0	5.2	6.0	6.2	5.7	6.1	6.1
3.7 ≤ E < 3.9	5.0	5.1	5.9	6.2	5.6	6.0	6.0
3.9 ≤ E < 4.1	4.9	5.1	5.9	6.1	5.5	6.0	6.0
4.1 ≤ E < 4.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
4.3 ≤ E < 4.5	4.9	5.0	5.8	6.0	5.4	5.9	5.9
4.5 ≤ E < 4.7	4.8	4.9	5.7	5.9	5.4	5.8	5.8
4.7 ≤ E < 4.9	4.8	4.9	5.7	5.9	5.3	5.8	5.8
E ≥ 4.9	4.7	4.9	5.7	5.9	5.3	5.8	5.8

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.7	5.8	6.8	7.0	6.3	6.9	6.9
2.7 ≤ E < 2.9	5.6	5.7	6.7	6.9	6.2	6.8	6.8
2.9 ≤ E < 3.1	5.5	5.6	6.6	6.8	6.0	6.7	6.7
3.1 ≤ E < 3.3	5.4	5.6	6.5	6.7	6.0	6.6	6.6
3.3 ≤ E < 3.5	5.3	5.5	6.4	6.6	5.9	6.5	6.5
3.5 ≤ E < 3.7	5.3	5.4	6.3	6.5	5.9	6.4	6.4
3.7 ≤ E < 3.9	5.2	5.3	6.2	6.5	5.8	6.3	6.3
3.9 ≤ E < 4.1	5.1	5.3	6.1	6.4	5.7	6.2	6.2
4.1 ≤ E < 4.3	5.0	5.2	6.0	6.3	5.7	6.2	6.1
4.3 ≤ E < 4.5	5.0	5.2	6.0	6.2	5.6	6.1	6.1
4.5 ≤ E < 4.7	5.0	5.1	5.9	6.2	5.6	6.0	6.0
4.7 ≤ E < 4.9	4.9	5.0	5.9	6.1	5.5	6.0	6.0
E ≥ 4.9	4.9	5.0	5.8	6.0	5.5	6.0	5.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.9	6.0	7.1	7.4	6.6	7.2	7.2
2.7 ≤ E < 2.9	5.8	5.9	7.0	7.3	6.5	7.0	7.0
2.9 ≤ E < 3.1	5.7	5.8	6.9	7.1	6.4	6.9	6.9
3.1 ≤ E < 3.3	5.6	5.8	6.8	7.0	6.2	6.8	6.8
3.3 ≤ E < 3.5	5.5	5.7	6.7	6.9	6.1	6.8	6.7
3.5 ≤ E < 3.7	5.5	5.6	6.6	6.8	6.0	6.7	6.7
3.7 ≤ E < 3.9	5.4	5.6	6.5	6.8	6.0	6.6	6.6
3.9 ≤ E < 4.1	5.3	5.5	6.4	6.7	5.9	6.5	6.5
4.1 ≤ E < 4.3	5.3	5.4	6.3	6.6	5.9	6.4	6.4
4.3 ≤ E < 4.5	5.2	5.4	6.2	6.5	5.8	6.4	6.4
4.5 ≤ E < 4.7	5.1	5.3	6.2	6.5	5.8	6.3	6.3
4.7 ≤ E < 4.9	5.1	5.3	6.1	6.4	5.7	6.2	6.2
E ≥ 4.9	5.0	5.2	6.0	6.3	5.7	6.2	6.2

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.0	6.2	7.3	7.7	6.7	7.4	7.4
2.9 ≤ E < 3.1	5.9	6.0	7.2	7.6	6.6	7.3	7.3
3.1 ≤ E < 3.3	5.8	6.0	7.0	7.4	6.5	7.2	7.1
3.3 ≤ E < 3.5	5.7	5.9	6.9	7.3	6.4	7.0	7.0
3.5 ≤ E < 3.7	5.7	5.8	6.8	7.2	6.3	6.9	6.9
3.7 ≤ E < 3.9	5.6	5.8	6.8	7.0	6.2	6.9	6.9
3.9 ≤ E < 4.1	5.5	5.7	6.7	7.0	6.2	6.8	6.8
4.1 ≤ E < 4.3	5.5	5.6	6.6	6.9	6.1	6.7	6.7
4.3 ≤ E < 4.5	5.4	5.6	6.5	6.8	6.0	6.7	6.6
4.5 ≤ E < 4.7	5.3	5.5	6.5	6.7	6.0	6.6	6.6
4.7 ≤ E < 4.9	5.3	5.5	6.4	6.7	5.9	6.5	6.5
E ≥ 4.9	5.2	5.4	6.3	6.6	5.9	6.5	6.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.2	6.5	7.7	8.1	7.0	7.8	7.8
2.9 ≤ E < 3.1	6.1	6.3	7.6	7.9	6.9	7.7	7.7
3.1 ≤ E < 3.3	6.0	6.2	7.4	7.8	6.8	7.5	7.5
3.3 ≤ E < 3.5	5.9	6.1	7.3	7.7	6.7	7.4	7.4
3.5 ≤ E < 3.7	5.9	6.0	7.2	7.6	6.6	7.3	7.3
3.7 ≤ E < 3.9	5.8	6.0	7.0	7.4	6.5	7.2	7.2
3.9 ≤ E < 4.1	5.7	5.9	7.0	7.3	6.4	7.1	7.1
4.1 ≤ E < 4.3	5.7	5.8	6.9	7.2	6.4	7.0	7.0
4.3 ≤ E < 4.5	5.6	5.8	6.8	7.1	6.3	6.9	6.9
4.5 ≤ E < 4.7	5.5	5.7	6.7	7.0	6.2	6.9	6.9
4.7 ≤ E < 4.9	5.5	5.7	6.7	7.0	6.2	6.8	6.8
E ≥ 4.9	5.4	5.6	6.6	6.9	6.1	6.7	6.7

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.5	6.8	8.1	8.6	7.4	8.2	8.2
2.9 ≤ E < 3.1	6.4	6.6	8.0	8.4	7.2	8.1	8.0
3.1 ≤ E < 3.3	6.3	6.5	7.8	8.3	7.1	7.9	7.9
3.3 ≤ E < 3.5	6.2	6.4	7.7	8.1	7.0	7.8	7.8
3.5 ≤ E < 3.7	6.1	6.3	7.6	7.9	6.9	7.7	7.7
3.7 ≤ E < 3.9	6.0	6.2	7.4	7.8	6.8	7.6	7.5
3.9 ≤ E < 4.1	5.9	6.1	7.3	7.7	6.7	7.5	7.4
4.1 ≤ E < 4.3	5.9	6.0	7.2	7.6	6.6	7.3	7.3
4.3 ≤ E < 4.5	5.8	6.0	7.1	7.5	6.6	7.3	7.2
4.5 ≤ E < 4.7	5.7	5.9	7.0	7.4	6.5	7.2	7.1
4.7 ≤ E < 4.9	5.7	5.9	7.0	7.3	6.4	7.1	7.1
E ≥ 4.9	5.6	5.8	6.9	7.3	6.4	7.0	7.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.8	7.0	8.6	9.2	7.8	8.7	8.7
2.9 ≤ E < 3.1	6.7	6.9	8.4	8.9	7.6	8.6	8.5
3.1 ≤ E < 3.3	6.6	6.8	8.2	8.8	7.5	8.4	8.4
3.3 ≤ E < 3.5	6.5	6.7	8.0	8.6	7.3	8.2	8.2
3.5 ≤ E < 3.7	6.3	6.6	7.9	8.4	7.2	8.0	8.0
3.7 ≤ E < 3.9	6.2	6.5	7.8	8.3	7.1	7.9	7.9
3.9 ≤ E < 4.1	6.1	6.4	7.7	8.1	7.0	7.8	7.8
4.1 ≤ E < 4.3	6.0	6.3	7.6	8.0	6.9	7.7	7.7
4.3 ≤ E < 4.5	6.0	6.2	7.5	7.9	6.8	7.6	7.6
4.5 ≤ E < 4.7	5.9	6.1	7.4	7.8	6.8	7.5	7.5
4.7 ≤ E < 4.9	5.9	6.1	7.3	7.7	6.7	7.5	7.4
E ≥ 4.9	5.8	6.0	7.2	7.6	6.6	7.4	7.4

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.1	7.4	9.2	9.8	8.2	9.3	9.3
2.9 ≤ E < 3.1	7.0	7.3	8.9	9.5	8.0	9.0	9.0
3.1 ≤ E < 3.3	6.9	7.1	8.7	9.3	7.9	8.9	8.8
3.3 ≤ E < 3.5	6.7	7.0	8.6	9.1	7.7	8.7	8.7
3.5 ≤ E < 3.7	6.6	6.9	8.4	8.9	7.6	8.5	8.5
3.7 ≤ E < 3.9	6.5	6.8	8.2	8.8	7.5	8.4	8.4
3.9 ≤ E < 4.1	6.4	6.7	8.1	8.6	7.3	8.2	8.2
4.1 ≤ E < 4.3	6.3	6.6	8.0	8.5	7.2	8.1	8.1
4.3 ≤ E < 4.5	6.2	6.5	7.9	8.3	7.1	8.0	8.0
4.5 ≤ E < 4.7	6.1	6.4	7.8	8.2	7.0	7.9	7.9
4.7 ≤ E < 4.9	6.1	6.3	7.7	8.1	7.0	7.8	7.8
E ≥ 4.9	6.0	6.3	7.6	8.0	6.9	7.7	7.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.3	7.5	9.5	10.2	8.5	9.6	9.6
3.1 ≤ E < 3.3	7.2	7.4	9.3	9.9	8.3	9.4	9.4
3.3 ≤ E < 3.5	7.0	7.2	9.0	9.7	8.1	9.2	9.2
3.5 ≤ E < 3.7	6.9	7.1	8.9	9.5	8.0	9.0	9.0
3.7 ≤ E < 3.9	6.8	7.0	8.7	9.3	7.8	8.9	8.8
3.9 ≤ E < 4.1	6.7	6.9	8.6	9.1	7.7	8.7	8.7
4.1 ≤ E < 4.3	6.6	6.8	8.4	9.0	7.6	8.6	8.6
4.3 ≤ E < 4.5	6.5	6.7	8.3	8.8	7.5	8.4	8.4
4.5 ≤ E < 4.7	6.4	6.6	8.2	8.7	7.4	8.3	8.3
4.7 ≤ E < 4.9	6.3	6.5	8.0	8.6	7.3	8.2	8.2
E ≥ 4.9	6.3	6.5	7.9	8.5	7.2	8.1	8.1

Table 2-13 **Loading Table for PWR Fuel – 959 W/Assembly (continued)**

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.6	7.9	10.1	11.0	9.0	10.3	10.2
3.1 ≤ E < 3.3	7.4	7.8	9.9	10.6	8.8	10.0	10.0
3.3 ≤ E < 3.5	7.2	7.6	9.6	10.4	8.6	9.8	9.8
3.5 ≤ E < 3.7	7.1	7.4	9.4	10.1	8.4	9.6	9.6
3.7 ≤ E < 3.9	7.0	7.3	9.2	9.9	8.2	9.4	9.4
3.9 ≤ E < 4.1	6.9	7.2	9.0	9.7	8.1	9.2	9.2
4.1 ≤ E < 4.3	6.8	7.0	8.9	9.5	8.0	9.0	9.0
4.3 ≤ E < 4.5	6.7	7.0	8.8	9.4	7.9	8.9	8.9
4.5 ≤ E < 4.7	6.6	6.9	8.6	9.2	7.8	8.8	8.8
4.7 ≤ E < 4.9	6.5	6.8	8.5	9.1	7.7	8.7	8.7
E ≥ 4.9	6.4	6.7	8.4	9.0	7.6	8.6	8.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.9	8.3	10.9	11.4	9.5	11.0	11.0
3.1 ≤ E < 3.3	7.8	8.1	10.6	11.1	9.3	10.7	10.7
3.3 ≤ E < 3.5	7.6	8.0	10.3	10.8	9.0	10.4	10.4
3.5 ≤ E < 3.7	7.4	7.8	10.0	10.6	8.9	10.2	10.2
3.7 ≤ E < 3.9	7.3	7.7	9.8	10.3	8.7	10.0	9.9
3.9 ≤ E < 4.1	7.2	7.5	9.6	10.1	8.5	9.8	9.8
4.1 ≤ E < 4.3	7.0	7.4	9.4	9.9	8.4	9.6	9.6
4.3 ≤ E < 4.5	6.9	7.3	9.3	9.8	8.3	9.5	9.4
4.5 ≤ E < 4.7	6.9	7.2	9.1	9.6	8.1	9.3	9.3
4.7 ≤ E < 4.9	6.8	7.1	9.0	9.5	8.0	9.2	9.1
E ≥ 4.9	6.7	7.0	8.9	9.3	7.9	9.0	9.0

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.4	8.8	11.3	12.2	10.1	11.7	11.7
3.1 ≤ E < 3.3	8.1	8.6	11.0	11.9	9.9	11.4	11.4
3.3 ≤ E < 3.5	8.0	8.4	10.7	11.6	9.6	11.2	11.2
3.5 ≤ E < 3.7	7.8	8.2	10.4	11.3	9.4	10.9	10.9
3.7 ≤ E < 3.9	7.7	8.1	10.2	11.1	9.2	10.7	10.6
3.9 ≤ E < 4.1	7.5	7.9	9.9	10.8	9.0	10.4	10.4
4.1 ≤ E < 4.3	7.4	7.8	9.8	10.6	8.8	10.2	10.2
4.3 ≤ E < 4.5	7.3	7.7	9.6	10.4	8.7	10.0	10.0
4.5 ≤ E < 4.7	7.1	7.6	9.5	10.2	8.6	9.9	9.8
4.7 ≤ E < 4.9	7.0	7.4	9.3	10.0	8.5	9.7	9.7
E ≥ 4.9	7.0	7.3	9.2	9.9	8.3	9.6	9.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.8	9.3	12.0	13.1	10.8	12.5	12.5
3.1 ≤ E < 3.3	8.6	9.1	11.7	12.7	10.5	12.2	12.1
3.3 ≤ E < 3.5	8.4	8.9	11.4	12.3	10.2	11.9	11.9
3.5 ≤ E < 3.7	8.2	8.7	11.1	12.0	10.0	11.6	11.6
3.7 ≤ E < 3.9	8.0	8.5	10.9	11.8	9.8	11.4	11.4
3.9 ≤ E < 4.1	7.9	8.3	10.6	11.5	9.6	11.1	11.1
4.1 ≤ E < 4.3	7.7	8.2	10.4	11.3	9.4	10.9	10.9
4.3 ≤ E < 4.5	7.6	8.0	10.2	11.1	9.2	10.7	10.7
4.5 ≤ E < 4.7	7.5	7.9	10.0	10.9	9.0	10.5	10.5
4.7 ≤ E < 4.9	7.4	7.8	9.9	10.7	8.9	10.3	10.3
E ≥ 4.9	7.3	7.9	9.7	10.6	8.8	10.2	10.1

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	9.1	9.7	12.5	13.6	11.2	13.0	13.0
3.3 ≤ E < 3.5	8.8	9.4	12.1	13.2	10.9	12.7	12.7
3.5 ≤ E < 3.7	8.7	9.2	11.8	12.9	10.7	12.4	12.4
3.7 ≤ E < 3.9	8.5	9.0	11.6	12.6	10.4	12.1	12.0
3.9 ≤ E < 4.1	8.3	8.8	11.3	12.2	10.1	11.8	11.8
4.1 ≤ E < 4.3	8.1	8.6	11.1	12.0	9.9	11.6	11.6
4.3 ≤ E < 4.5	8.0	8.5	10.9	11.8	9.7	11.4	11.4
4.5 ≤ E < 4.7	7.9	8.3	10.7	11.6	9.6	11.2	11.2
4.7 ≤ E < 4.9	7.7	8.2	10.5	11.4	9.4	11.0	11.0
E ≥ 4.9	7.6	8.1	10.3	11.3	9.3	10.9	10.8
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)**						
	CE 14x14	**WE 14x14**	**WE 15x15**	**B&W 15x15**	**CE 16x16**	**WE 17x17**	**B&W 17x17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	9.6	10.3	13.3	14.5	11.6	13.9	13.9
3.3 ≤ E < 3.5	9.4	10.0	13.0	14.1	11.3	13.6	13.5
3.5 ≤ E < 3.7	9.1	9.7	12.6	13.8	11.0	13.3	13.2
3.7 ≤ E < 3.9	8.9	9.5	12.3	13.4	10.8	12.9	12.9
3.9 ≤ E < 4.1	8.7	9.3	12.0	13.2	10.5	12.7	12.6
4.1 ≤ E < 4.3	8.6	9.1	11.8	12.9	10.3	12.4	12.3
4.3 ≤ E < 4.5	8.4	8.9	11.6	12.6	10.0	12.1	12.1
4.5 ≤ E < 4.7	8.2	8.8	11.4	12.4	9.9	11.9	11.9
4.7 ≤ E < 4.9	8.1	8.6	11.2	12.2	9.7	11.7	11.7
E ≥ 4.9	8.0	8.5	11.0	12.0	9.6	11.5	11.5

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	10.2	10.9	14.2	15.4	12.4	14.9	14.8
3.3 ≤ E < 3.5	9.9	10.7	13.8	15.0	12.0	14.5	14.4
3.5 ≤ E < 3.7	9.6	10.3	13.4	14.7	11.7	14.1	14.0
3.7 ≤ E < 3.9	9.4	10.0	13.1	14.3	11.4	13.8	13.7
3.9 ≤ E < 4.1	9.2	9.8	12.8	14.0	11.2	13.5	13.4
4.1 ≤ E < 4.3	9.0	9.6	12.5	13.7	10.9	13.2	13.2
4.3 ≤ E < 4.5	8.8	9.4	12.3	13.5	10.7	13.0	12.9
4.5 ≤ E < 4.7	8.7	9.3	12.0	13.2	10.5	12.7	12.7
4.7 ≤ E < 4.9	8.5	9.1	11.8	13.0	10.3	12.4	12.4
E ≥ 4.9	8.4	8.9	11.6	12.8	10.1	12.2	12.2
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)**						
	CE 14x14	**WE 14x14**	**WE 15x15**	**B&W 15x15**	**CE 16x16**	**WE 17x17**	**B&W 17x17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	10.8	11.6	15.1	16.4	13.2	15.8	15.8
3.3 ≤ E < 3.5	10.5	11.3	14.7	16.0	12.8	15.4	15.4
3.5 ≤ E < 3.7	10.2	11.0	14.3	15.6	12.4	15.0	15.0
3.7 ≤ E < 3.9	9.9	10.7	14.0	15.3	12.1	14.7	14.6
3.9 ≤ E < 4.1	9.7	10.5	13.7	14.9	11.8	14.3	14.3
4.1 ≤ E < 4.3	9.5	10.2	13.4	14.6	11.6	14.0	14.0
4.3 ≤ E < 4.5	9.3	10.0	13.1	14.3	11.4	13.8	13.7
4.5 ≤ E < 4.7	9.1	9.8	12.8	14.0	11.1	13.5	13.5
4.7 ≤ E < 4.9	8.9	9.6	12.6	13.8	11.0	13.3	13.3
E ≥ 4.9	8.8	9.4	12.4	13.6	10.8	13.0	13.0

Table 2-13 Loading Table for PWR Fuel – 959 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	11.5	12.4	16.0	17.4	14.0	16.7	16.7
3.3 ≤ E < 3.5	11.2	12.0	15.6	17.0	13.6	16.3	16.3
3.5 ≤ E < 3.7	10.8	11.7	15.2	16.6	13.2	16.0	15.9
3.7 ≤ E < 3.9	10.6	11.4	14.9	16.2	12.9	15.6	15.6
3.9 ≤ E < 4.1	10.3	11.1	14.5	15.9	12.6	15.3	15.3
4.1 ≤ E < 4.3	10.0	10.9	14.2	15.5	12.3	14.9	14.9
4.3 ≤ E < 4.5	9.8	10.6	13.9	15.3	12.0	14.7	14.6
4.5 ≤ E < 4.7	9.6	10.4	13.7	15.0	11.8	14.4	14.3
4.7 ≤ E < 4.9	9.4	10.2	13.4	14.7	11.6	14.1	14.1
E ≥ 4.9	9.3	10.0	13.2	14.4	11.4	13.9	13.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	11.8	12.8	16.5	17.9	14.4	16.9	16.8
3.5 ≤ E < 3.7	11.5	12.4	16.1	17.6	14.0	16.5	16.4
3.7 ≤ E < 3.9	11.2	12.0	15.8	17.2	13.7	16.1	16.0
3.9 ≤ E < 4.1	10.9	11.8	15.4	16.8	13.4	15.8	15.7
4.1 ≤ E < 4.3	10.7	11.5	15.1	16.5	13.1	15.4	15.4
4.3 ≤ E < 4.5	10.4	11.3	14.8	16.1	12.8	15.1	15.1
4.5 ≤ E < 4.7	10.1	11.1	14.5	15.9	12.5	14.9	14.8
4.7 ≤ E < 4.9	10.0	10.8	14.2	15.6	12.3	14.6	14.6
E ≥ 4.9	9.8	10.6	13.9	15.4	12.0	14.3	14.3

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.3 ≤ E < 2.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.5 ≤ E < 2.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.7 ≤ E < 2.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.9 ≤ E < 3.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.1 ≤ E < 3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.3 ≤ E < 3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.0	4.0	4.0	4.1	4.0	4.1	4.1
2.5 ≤ E < 2.7	4.0	4.0	4.0	4.1	4.0	4.0	4.0
2.7 ≤ E < 2.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
2.9 ≤ E < 3.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.1 ≤ E < 3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.3 ≤ E < 3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.0	4.0	4.3	4.4	4.2	4.4	4.4
2.5 ≤ E < 2.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
2.7 ≤ E < 2.9	4.0	4.0	4.2	4.3	4.1	4.3	4.3
2.9 ≤ E < 3.1	4.0	4.0	4.2	4.3	4.0	4.3	4.3
3.1 ≤ E < 3.3	4.0	4.0	4.1	4.2	4.0	4.2	4.2
3.3 ≤ E < 3.5	4.0	4.0	4.1	4.2	4.0	4.2	4.2
3.5 ≤ E < 3.7	4.0	4.0	4.0	4.2	4.0	4.2	4.2
3.7 ≤ E < 3.9	4.0	4.0	4.0	4.1	4.0	4.1	4.1
3.9 ≤ E < 4.1	4.0	4.0	4.0	4.1	4.0	4.1	4.1
4.1 ≤ E < 4.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.3 ≤ E < 4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.0	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.0	4.1	4.6	4.8	4.4	4.7	4.7
2.7 ≤ E < 2.9	4.0	4.0	4.6	4.7	4.4	4.7	4.7
2.9 ≤ E < 3.1	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.1 ≤ E < 3.3	4.0	4.0	4.5	4.6	4.3	4.5	4.5
3.3 ≤ E < 3.5	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.5 ≤ E < 3.7	4.0	4.0	4.4	4.5	4.2	4.5	4.4
3.7 ≤ E < 3.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
3.9 ≤ E < 4.1	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.1 ≤ E < 4.3	4.0	4.0	4.2	4.3	4.1	4.3	4.3
4.3 ≤ E < 4.5	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.5 ≤ E < 4.7	4.0	4.0	4.2	4.3	4.0	4.3	4.3
4.7 ≤ E < 4.9	4.0	4.0	4.1	4.3	4.0	4.3	4.3
E ≥ 4.9	4.0	4.0	4.1	4.2	4.0	4.2	4.2

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.2	4.2	4.8	4.9	4.5	4.9	4.9
2.7 ≤ E < 2.9	4.1	4.2	4.7	4.8	4.5	4.8	4.8
2.9 ≤ E < 3.1	4.0	4.1	4.7	4.8	4.4	4.8	4.7
3.1 ≤ E < 3.3	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.3 ≤ E < 3.5	4.0	4.0	4.5	4.7	4.4	4.6	4.6
3.5 ≤ E < 3.7	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.7 ≤ E < 3.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.9 ≤ E < 4.1	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.1 ≤ E < 4.3	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.3 ≤ E < 4.5	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.5 ≤ E < 4.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.7 ≤ E < 4.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
E ≥ 4.9	4.0	4.0	4.2	4.3	4.0	4.4	4.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.3	4.4	4.9	5.1	4.7	5.0	5.0
2.7 ≤ E < 2.9	4.2	4.3	4.9	5.0	4.6	5.0	5.0
2.9 ≤ E < 3.1	4.2	4.2	4.8	4.9	4.6	4.9	4.9
3.1 ≤ E < 3.3	4.1	4.2	4.7	4.9	4.5	4.8	4.8
3.3 ≤ E < 3.5	4.0	4.1	4.7	4.8	4.5	4.8	4.8
3.5 ≤ E < 3.7	4.0	4.1	4.6	4.8	4.4	4.7	4.7
3.7 ≤ E < 3.9	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.9 ≤ E < 4.1	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.1 ≤ E < 4.3	4.0	4.0	4.5	4.6	4.3	4.6	4.6
4.3 ≤ E < 4.5	4.0	4.0	4.4	4.6	4.3	4.5	4.5
4.5 ≤ E < 4.7	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.7 ≤ E < 4.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5
E ≥ 4.9	4.0	4.0	4.3	4.5	4.2	4.5	4.5

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.4	4.5	5.1	5.3	4.9	5.2	5.2
2.7 ≤ E < 2.9	4.4	4.4	5.0	5.2	4.8	5.1	5.1
2.9 ≤ E < 3.1	4.3	4.4	5.0	5.1	4.7	5.0	5.0
3.1 ≤ E < 3.3	4.2	4.3	4.9	5.0	4.7	5.0	5.0
3.3 ≤ E < 3.5	4.2	4.3	4.8	5.0	4.6	4.9	4.9
3.5 ≤ E < 3.7	4.1	4.2	4.8	4.9	4.5	4.9	4.9
3.7 ≤ E < 3.9	4.1	4.2	4.7	4.9	4.5	4.8	4.8
3.9 ≤ E < 4.1	4.0	4.1	4.7	4.8	4.4	4.8	4.8
4.1 ≤ E < 4.3	4.0	4.1	4.6	4.8	4.4	4.7	4.7
4.3 ≤ E < 4.5	4.0	4.0	4.6	4.7	4.4	4.7	4.7
4.5 ≤ E < 4.7	4.0	4.0	4.5	4.7	4.3	4.7	4.6
4.7 ≤ E < 4.9	4.0	4.0	4.5	4.6	4.3	4.6	4.6
E ≥ 4.9	4.0	4.0	4.4	4.6	4.3	4.6	4.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
2.7 ≤ E < 2.9	4.5	4.6	5.2	5.4	4.9	5.3	5.3
2.9 ≤ E < 3.1	4.4	4.5	5.1	5.3	4.9	5.2	5.2
3.1 ≤ E < 3.3	4.4	4.4	5.0	5.2	4.8	5.2	5.2
3.3 ≤ E < 3.5	4.3	4.4	5.0	5.1	4.7	5.1	5.1
3.5 ≤ E < 3.7	4.2	4.3	4.9	5.1	4.7	5.0	5.0
3.7 ≤ E < 3.9	4.2	4.3	4.9	5.0	4.6	5.0	5.0
3.9 ≤ E < 4.1	4.1	4.3	4.8	5.0	4.6	4.9	4.9
4.1 ≤ E < 4.3	4.1	4.2	4.8	4.9	4.5	4.9	4.9
4.3 ≤ E < 4.5	4.1	4.2	4.7	4.9	4.5	4.8	4.8
4.5 ≤ E < 4.7	4.0	4.2	4.7	4.8	4.5	4.8	4.8
4.7 ≤ E < 4.9	4.0	4.1	4.6	4.8	4.4	4.8	4.7
E ≥ 4.9	4.0	4.1	4.6	4.8	4.4	4.7	4.7

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	4.6	4.7	5.4	5.6	5.1	5.5	5.5
2.9 ≤ E < 3.1	4.5	4.6	5.3	5.5	5.0	5.4	5.4
3.1 ≤ E < 3.3	4.5	4.6	5.2	5.4	4.9	5.4	5.4
3.3 ≤ E < 3.5	4.4	4.5	5.2	5.4	4.9	5.3	5.3
3.5 ≤ E < 3.7	4.4	4.5	5.1	5.3	4.8	5.2	5.2
3.7 ≤ E < 3.9	4.3	4.4	5.0	5.2	4.8	5.1	5.1
3.9 ≤ E < 4.1	4.3	4.4	5.0	5.1	4.7	5.1	5.1
4.1 ≤ E < 4.3	4.2	4.3	4.9	5.1	4.7	5.0	5.0
4.3 ≤ E < 4.5	4.2	4.3	4.9	5.0	4.6	5.0	5.0
4.5 ≤ E < 4.7	4.1	4.2	4.8	5.0	4.6	4.9	4.9
4.7 ≤ E < 4.9	4.1	4.2	4.8	4.9	4.5	4.9	4.9
E ≥ 4.9	4.0	4.2	4.7	4.9	4.5	4.9	4.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	4.8	4.9	5.6	5.8	5.3	5.7	5.7
2.9 ≤ E < 3.1	4.7	4.8	5.5	5.7	5.2	5.6	5.6
3.1 ≤ E < 3.3	4.6	4.7	5.5	5.6	5.1	5.6	5.5
3.3 ≤ E < 3.5	4.5	4.7	5.4	5.6	5.0	5.5	5.5
3.5 ≤ E < 3.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
3.7 ≤ E < 3.9	4.4	4.5	5.2	5.4	4.9	5.3	5.3
3.9 ≤ E < 4.1	4.4	4.5	5.1	5.3	4.9	5.3	5.3
4.1 ≤ E < 4.3	4.4	4.4	5.1	5.3	4.8	5.2	5.2
4.3 ≤ E < 4.5	4.3	4.4	5.0	5.2	4.8	5.1	5.1
4.5 ≤ E < 4.7	4.3	4.4	5.0	5.1	4.7	5.1	5.1
4.7 ≤ E < 4.9	4.2	4.3	4.9	5.1	4.7	5.0	5.0
E ≥ 4.9	4.2	4.3	4.9	5.0	4.6	5.0	5.0

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	4.9	5.0	5.8	6.0	5.5	5.9	5.9
2.9 ≤ E < 3.1	4.8	4.9	5.7	5.9	5.4	5.8	5.8
3.1 ≤ E < 3.3	4.8	4.9	5.7	5.8	5.3	5.7	5.8
3.3 ≤ E < 3.5	4.7	4.8	5.6	5.7	5.2	5.7	5.7
3.5 ≤ E < 3.7	4.6	4.7	5.5	5.7	5.1	5.6	5.6
3.7 ≤ E < 3.9	4.6	4.7	5.4	5.6	5.1	5.5	5.5
3.9 ≤ E < 4.1	4.5	4.6	5.3	5.5	5.0	5.5	5.5
4.1 ≤ E < 4.3	4.5	4.6	5.3	5.5	4.9	5.4	5.4
4.3 ≤ E < 4.5	4.4	4.5	5.2	5.4	4.9	5.3	5.3
4.5 ≤ E < 4.7	4.4	4.5	5.1	5.3	4.9	5.3	5.2
4.7 ≤ E < 4.9	4.3	4.4	5.1	5.3	4.8	5.2	5.2
E ≥ 4.9	4.3	4.4	5.0	5.2	4.8	5.2	5.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	5.1	5.2	6.0	6.3	5.7	6.1	6.1
2.9 ≤ E < 3.1	5.0	5.1	5.9	6.1	5.6	6.0	6.0
3.1 ≤ E < 3.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.3 ≤ E < 3.5	4.8	5.0	5.8	5.9	5.4	5.9	5.9
3.5 ≤ E < 3.7	4.8	4.9	5.7	5.9	5.3	5.8	5.8
3.7 ≤ E < 3.9	4.7	4.8	5.6	5.8	5.3	5.7	5.7
3.9 ≤ E < 4.1	4.7	4.8	5.5	5.7	5.2	5.7	5.6
4.1 ≤ E < 4.3	4.6	4.7	5.5	5.7	5.1	5.6	5.6
4.3 ≤ E < 4.5	4.5	4.7	5.4	5.6	5.0	5.5	5.5
4.5 ≤ E < 4.7	4.5	4.6	5.3	5.6	5.0	5.5	5.5
4.7 ≤ E < 4.9	4.5	4.6	5.3	5.5	4.9	5.4	5.4
E ≥ 4.9	4.4	4.5	5.2	5.4	4.9	5.4	5.3

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	5.3	5.4	6.3	6.6	5.9	6.4	6.4
2.9 ≤ E < 3.1	5.2	5.3	6.2	6.4	5.8	6.3	6.3
3.1 ≤ E < 3.3	5.1	5.2	6.0	6.3	5.7	6.1	6.1
3.3 ≤ E < 3.5	5.0	5.1	6.0	6.2	5.6	6.0	6.0
3.5 ≤ E < 3.7	4.9	5.0	5.9	6.1	5.5	6.0	6.0
3.7 ≤ E < 3.9	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.9 ≤ E < 4.1	4.8	4.9	5.7	5.9	5.4	5.8	5.8
4.1 ≤ E < 4.3	4.7	4.9	5.7	5.9	5.3	5.8	5.8
4.3 ≤ E < 4.5	4.7	4.8	5.6	5.8	5.2	5.7	5.7
4.5 ≤ E < 4.7	4.6	4.8	5.5	5.7	5.2	5.7	5.7
4.7 ≤ E < 4.9	4.5	4.7	5.5	5.7	5.1	5.6	5.6
E ≥ 4.9	4.5	4.6	5.4	5.6	5.0	5.5	5.5
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)**						
	CE 14x14	**WE 14x14**	**WE 15x15**	**B&W 15x15**	**CE 16x16**	**WE 17x17**	**B&W 17x17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.4	5.5	6.4	6.7	6.0	6.5	6.5
3.1 ≤ E < 3.3	5.3	5.4	6.3	6.6	5.9	6.4	6.4
3.3 ≤ E < 3.5	5.2	5.3	6.2	6.5	5.8	6.3	6.3
3.5 ≤ E < 3.7	5.1	5.2	6.1	6.4	5.7	6.2	6.2
3.7 ≤ E < 3.9	5.0	5.1	6.0	6.2	5.6	6.1	6.1
3.9 ≤ E < 4.1	4.9	5.0	5.9	6.1	5.6	6.0	6.0
4.1 ≤ E < 4.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
4.3 ≤ E < 4.5	4.8	4.9	5.8	6.0	5.4	5.9	5.9
4.5 ≤ E < 4.7	4.8	4.9	5.7	5.9	5.3	5.8	5.8
4.7 ≤ E < 4.9	4.7	4.8	5.7	5.9	5.3	5.8	5.8
E ≥ 4.9	4.7	4.8	5.6	5.8	5.2	5.7	5.7

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.5	5.7	6.7	7.0	6.2	6.8	6.8
3.1 ≤ E < 3.3	5.4	5.6	6.6	6.9	6.1	6.7	6.7
3.3 ≤ E < 3.5	5.3	5.5	6.5	6.7	6.0	6.6	6.6
3.5 ≤ E < 3.7	5.2	5.4	6.3	6.6	5.9	6.5	6.5
3.7 ≤ E < 3.9	5.1	5.3	6.2	6.5	5.8	6.4	6.4
3.9 ≤ E < 4.1	5.0	5.2	6.1	6.4	5.7	6.3	6.3
4.1 ≤ E < 4.3	5.0	5.1	6.0	6.3	5.7	6.2	6.2
4.3 ≤ E < 4.5	4.9	5.0	6.0	6.2	5.6	6.1	6.1
4.5 ≤ E < 4.7	4.9	5.0	5.9	6.1	5.5	6.0	6.0
4.7 ≤ E < 4.9	4.8	4.9	5.8	6.0	5.5	6.0	6.0
E ≥ 4.9	4.8	4.9	5.8	6.0	5.4	5.9	5.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.7	5.8	7.0	7.2	6.5	7.1	7.1
3.1 ≤ E < 3.3	5.6	5.7	6.8	7.0	6.3	7.0	6.9
3.3 ≤ E < 3.5	5.5	5.7	6.7	6.9	6.2	6.8	6.8
3.5 ≤ E < 3.7	5.4	5.6	6.6	6.8	6.1	6.7	6.7
3.7 ≤ E < 3.9	5.3	5.5	6.5	6.7	6.0	6.6	6.6
3.9 ≤ E < 4.1	5.2	5.4	6.4	6.6	5.9	6.5	6.5
4.1 ≤ E < 4.3	5.1	5.3	6.3	6.5	5.9	6.4	6.4
4.3 ≤ E < 4.5	5.0	5.2	6.2	6.4	5.8	6.3	6.3
4.5 ≤ E < 4.7	5.0	5.2	6.1	6.3	5.7	6.3	6.2
4.7 ≤ E < 4.9	4.9	5.1	6.0	6.2	5.7	6.2	6.2
E ≥ 4.9	4.9	5.0	6.0	6.1	5.6	6.1	6.1

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	5.9	6.0	7.2	7.6	6.7	7.4	7.4
3.1 ≤ E < 3.3	5.8	5.9	7.0	7.4	6.6	7.3	7.3
3.3 ≤ E < 3.5	5.7	5.8	6.9	7.2	6.5	7.1	7.1
3.5 ≤ E < 3.7	5.6	5.8	6.8	7.1	6.4	7.0	7.0
3.7 ≤ E < 3.9	5.5	5.7	6.7	7.0	6.2	6.9	6.9
3.9 ≤ E < 4.1	5.4	5.6	6.6	6.9	6.1	6.8	6.8
4.1 ≤ E < 4.3	5.3	5.5	6.5	6.8	6.0	6.7	6.7
4.3 ≤ E < 4.5	5.2	5.4	6.4	6.7	6.0	6.6	6.6
4.5 ≤ E < 4.7	5.2	5.4	6.3	6.6	5.9	6.5	6.5
4.7 ≤ E < 4.9	5.1	5.3	6.2	6.5	5.8	6.4	6.4
E ≥ 4.9	5.0	5.2	6.1	6.4	5.8	6.3	6.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	6.0	6.3	7.5	7.9	7.0	7.8	7.8
3.1 ≤ E < 3.3	5.9	6.1	7.4	7.8	6.9	7.6	7.6
3.3 ≤ E < 3.5	5.8	6.0	7.2	7.6	6.7	7.5	7.5
3.5 ≤ E < 3.7	5.8	5.9	7.0	7.4	6.6	7.3	7.3
3.7 ≤ E < 3.9	5.7	5.9	6.9	7.3	6.5	7.2	7.2
3.9 ≤ E < 4.1	5.6	5.8	6.8	7.1	6.4	7.0	7.0
4.1 ≤ E < 4.3	5.5	5.7	6.7	7.0	6.3	6.9	6.9
4.3 ≤ E < 4.5	5.4	5.6	6.6	6.9	6.2	6.9	6.8
4.5 ≤ E < 4.7	5.3	5.6	6.5	6.8	6.1	6.8	6.8
4.7 ≤ E < 4.9	5.3	5.5	6.4	6.8	6.0	6.7	6.7
E ≥ 4.9	5.2	5.5	6.4	6.7	6.0	6.6	6.6

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	6.2	6.4	7.7	8.1	7.1	8.0	8.0
3.3 ≤ E < 3.5	6.0	6.3	7.5	7.9	7.0	7.8	7.8
3.5 ≤ E < 3.7	5.9	6.2	7.4	7.8	6.9	7.7	7.7
3.7 ≤ E < 3.9	5.9	6.0	7.2	7.6	6.8	7.5	7.5
3.9 ≤ E < 4.1	5.8	6.0	7.1	7.5	6.7	7.4	7.4
4.1 ≤ E < 4.3	5.7	5.9	7.0	7.4	6.6	7.2	7.2
4.3 ≤ E < 4.5	5.6	5.8	6.9	7.2	6.5	7.1	7.1
4.5 ≤ E < 4.7	5.6	5.7	6.8	7.1	6.3	7.0	7.0
4.7 ≤ E < 4.9	5.5	5.7	6.7	7.0	6.3	6.9	6.9
E ≥ 4.9	5.4	5.6	6.6	6.9	6.2	6.9	6.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	6.4	6.7	8.1	8.6	7.3	8.4	8.4
3.3 ≤ E < 3.5	6.3	6.6	7.9	8.4	7.2	8.2	8.2
3.5 ≤ E < 3.7	6.2	6.4	7.7	8.2	7.0	8.0	8.0
3.7 ≤ E < 3.9	6.0	6.3	7.6	8.0	6.9	7.9	7.9
3.9 ≤ E < 4.1	6.0	6.2	7.4	7.9	6.8	7.7	7.7
4.1 ≤ E < 4.3	5.9	6.1	7.3	7.7	6.7	7.6	7.6
4.3 ≤ E < 4.5	5.8	6.0	7.2	7.6	6.6	7.5	7.4
4.5 ≤ E < 4.7	5.7	5.9	7.0	7.5	6.5	7.3	7.3
4.7 ≤ E < 4.9	5.6	5.8	6.9	7.4	6.4	7.2	7.2
E ≥ 4.9	5.6	5.8	6.9	7.2	6.3	7.1	7.1

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	6.7	6.9	8.5	9.0	7.7	8.8	8.8
3.3 ≤ E < 3.5	6.6	6.8	8.3	8.8	7.5	8.6	8.6
3.5 ≤ E < 3.7	6.4	6.7	8.1	8.6	7.3	8.4	8.4
3.7 ≤ E < 3.9	6.3	6.6	7.9	8.4	7.2	8.2	8.2
3.9 ≤ E < 4.1	6.2	6.5	7.8	8.2	7.0	8.1	8.0
4.1 ≤ E < 4.3	6.0	6.3	7.6	8.1	6.9	7.9	7.9
4.3 ≤ E < 4.5	6.0	6.2	7.5	7.9	6.8	7.8	7.8
4.5 ≤ E < 4.7	5.9	6.1	7.4	7.8	6.7	7.7	7.7
4.7 ≤ E < 4.9	5.8	6.0	7.2	7.7	6.6	7.6	7.5
E ≥ 4.9	5.8	6.0	7.1	7.6	6.6	7.5	7.4
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	7.0	7.3	9.0	9.6	8.0	9.3	9.3
3.3 ≤ E < 3.5	6.8	7.1	8.7	9.3	7.9	9.1	9.0
3.5 ≤ E < 3.7	6.7	6.9	8.5	9.1	7.7	8.9	8.9
3.7 ≤ E < 3.9	6.5	6.8	8.3	8.9	7.5	8.7	8.7
3.9 ≤ E < 4.1	6.4	6.7	8.1	8.7	7.4	8.5	8.5
4.1 ≤ E < 4.3	6.3	6.6	8.0	8.5	7.2	8.3	8.3
4.3 ≤ E < 4.5	6.2	6.5	7.8	8.3	7.1	8.2	8.1
4.5 ≤ E < 4.7	6.1	6.4	7.7	8.2	7.0	8.0	8.0
4.7 ≤ E < 4.9	6.0	6.3	7.6	8.0	6.9	7.9	7.9
E ≥ 4.9	5.9	6.2	7.5	7.9	6.8	7.8	7.8

Table 2-14 Loading Table for PWR Fuel – 1,200 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	7.3	7.6	9.5	10.1	8.4	9.9	9.8
3.3 ≤ E < 3.5	7.1	7.4	9.2	9.9	8.2	9.6	9.6
3.5 ≤ E < 3.7	6.9	7.3	9.0	9.6	8.0	9.4	9.3
3.7 ≤ E < 3.9	6.8	7.1	8.8	9.4	7.9	9.1	9.1
3.9 ≤ E < 4.1	6.7	7.0	8.6	9.1	7.7	8.9	8.9
4.1 ≤ E < 4.3	6.6	6.8	8.4	8.9	7.6	8.7	8.7
4.3 ≤ E < 4.5	6.4	6.7	8.2	8.8	7.4	8.6	8.6
4.5 ≤ E < 4.7	6.3	6.6	8.0	8.6	7.3	8.4	8.4
4.7 ≤ E < 4.9	6.2	6.5	7.9	8.4	7.2	8.3	8.3
E ≥ 4.9	6.1	6.4	7.8	8.3	7.0	8.1	8.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	7.4	7.8	9.7	10.5	8.7	9.9	9.9
3.5 ≤ E < 3.7	7.2	7.6	9.5	10.1	8.4	9.6	9.6
3.7 ≤ E < 3.9	7.0	7.4	9.2	9.9	8.2	9.4	9.4
3.9 ≤ E < 4.1	6.9	7.3	9.0	9.7	8.0	9.2	9.1
4.1 ≤ E < 4.3	6.8	7.1	8.8	9.4	7.9	9.0	9.0
4.3 ≤ E < 4.5	6.7	7.0	8.6	9.2	7.7	8.8	8.8
4.5 ≤ E < 4.7	6.6	6.9	8.5	9.0	7.6	8.7	8.6
4.7 ≤ E < 4.9	6.5	6.8	8.3	8.9	7.5	8.5	8.5
E ≥ 4.9	6.4	6.7	8.1	8.7	7.4	8.4	8.3

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	4.2	4.3	4.8	4.9	4.6	4.9	4.9
2.3 ≤ E < 2.5	4.2	4.2	4.7	4.8	4.5	4.8	4.8
2.5 ≤ E < 2.7	4.1	4.2	4.7	4.8	4.5	4.8	4.8
2.7 ≤ E < 2.9	4.1	4.1	4.6	4.7	4.4	4.7	4.7
2.9 ≤ E < 3.1	4.0	4.1	4.6	4.7	4.4	4.7	4.7
3.1 ≤ E < 3.3	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.3 ≤ E < 3.5	4.0	4.0	4.5	4.6	4.3	4.6	4.6
3.5 ≤ E < 3.7	4.0	4.0	4.5	4.5	4.3	4.5	4.5
3.7 ≤ E < 3.9	4.0	4.0	4.4	4.5	4.2	4.5	4.5
3.9 ≤ E < 4.1	4.0	4.0	4.4	4.5	4.2	4.5	4.5
4.1 ≤ E < 4.3	4.0	4.0	4.4	4.5	4.2	4.4	4.4
4.3 ≤ E < 4.5	4.0	4.0	4.3	4.4	4.2	4.4	4.4
4.5 ≤ E < 4.7	4.0	4.0	4.3	4.4	4.1	4.4	4.4
4.7 ≤ E < 4.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4
E ≥ 4.9	4.0	4.0	4.3	4.4	4.1	4.4	4.4

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.5	4.6	5.2	5.3	4.9	5.3	5.3
2.5 ≤ E < 2.7	4.4	4.5	5.1	5.3	4.9	5.2	5.2
2.7 ≤ E < 2.9	4.4	4.5	5.0	5.2	4.8	5.1	5.1
2.9 ≤ E < 3.1	4.4	4.4	5.0	5.1	4.8	5.1	5.1
3.1 ≤ E < 3.3	4.3	4.4	4.9	5.0	4.7	5.0	5.0
3.3 ≤ E < 3.5	4.3	4.3	4.9	5.0	4.7	5.0	5.0
3.5 ≤ E < 3.7	4.2	4.3	4.8	5.0	4.6	4.9	4.9
3.7 ≤ E < 3.9	4.2	4.3	4.8	4.9	4.6	4.9	4.9
3.9 ≤ E < 4.1	4.1	4.2	4.8	4.9	4.5	4.9	4.9
4.1 ≤ E < 4.3	4.1	4.2	4.7	4.9	4.5	4.8	4.8
4.3 ≤ E < 4.5	4.1	4.2	4.7	4.8	4.5	4.8	4.8
4.5 ≤ E < 4.7	4.0	4.1	4.7	4.8	4.5	4.8	4.8
4.7 ≤ E < 4.9	4.0	4.1	4.6	4.8	4.4	4.7	4.7
E ≥ 4.9	4.0	4.1	4.6	4.7	4.4	4.7	4.7

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.9	5.0	5.7	5.9	5.4	5.8	5.8
2.5 ≤ E < 2.7	4.8	4.9	5.7	5.8	5.3	5.7	5.7
2.7 ≤ E < 2.9	4.8	4.9	5.6	5.8	5.3	5.7	5.7
2.9 ≤ E < 3.1	4.7	4.8	5.5	5.7	5.2	5.6	5.6
3.1 ≤ E < 3.3	4.6	4.7	5.4	5.6	5.1	5.5	5.5
3.3 ≤ E < 3.5	4.6	4.7	5.4	5.6	5.0	5.5	5.5
3.5 ≤ E < 3.7	4.5	4.6	5.3	5.5	5.0	5.4	5.4
3.7 ≤ E < 3.9	4.5	4.6	5.3	5.4	5.0	5.4	5.4
3.9 ≤ E < 4.1	4.5	4.6	5.2	5.4	4.9	5.3	5.3
4.1 ≤ E < 4.3	4.4	4.5	5.2	5.4	4.9	5.3	5.3
4.3 ≤ E < 4.5	4.4	4.5	5.1	5.3	4.9	5.2	5.2
4.5 ≤ E < 4.7	4.4	4.5	5.1	5.3	4.8	5.2	5.2
4.7 ≤ E < 4.9	4.3	4.4	5.0	5.2	4.8	5.2	5.2
E ≥ 4.9	4.3	4.4	5.0	5.2	4.8	5.1	5.1
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.3	5.4	6.2	6.5	5.9	6.3	6.3
2.7 ≤ E < 2.9	5.2	5.3	6.1	6.4	5.8	6.2	6.2
2.9 ≤ E < 3.1	5.1	5.3	6.0	6.3	5.7	6.1	6.1
3.1 ≤ E < 3.3	5.0	5.2	6.0	6.2	5.6	6.0	6.0
3.3 ≤ E < 3.5	5.0	5.1	5.9	6.1	5.6	6.0	6.0
3.5 ≤ E < 3.7	4.9	5.0	5.9	6.0	5.5	5.9	5.9
3.7 ≤ E < 3.9	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.9 ≤ E < 4.1	4.8	5.0	5.7	5.9	5.4	5.8	5.8
4.1 ≤ E < 4.3	4.8	4.9	5.7	5.9	5.4	5.8	5.8
4.3 ≤ E < 4.5	4.8	4.9	5.7	5.8	5.3	5.8	5.7
4.5 ≤ E < 4.7	4.7	4.8	5.6	5.8	5.3	5.7	5.7
4.7 ≤ E < 4.9	4.7	4.8	5.6	5.8	5.2	5.7	5.7
E ≥ 4.9	4.6	4.8	5.5	5.7	5.2	5.6	5.6

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.5	5.6	6.6	6.8	6.0	6.6	6.6
2.7 ≤ E < 2.9	5.4	5.6	6.4	6.7	6.0	6.5	6.5
2.9 ≤ E < 3.1	5.3	5.5	6.3	6.6	5.9	6.4	6.4
3.1 ≤ E < 3.3	5.3	5.4	6.2	6.5	5.8	6.3	6.3
3.3 ≤ E < 3.5	5.2	5.3	6.1	6.4	5.8	6.3	6.2
3.5 ≤ E < 3.7	5.1	5.3	6.1	6.3	5.7	6.2	6.2
3.7 ≤ E < 3.9	5.0	5.2	6.0	6.2	5.7	6.1	6.1
3.9 ≤ E < 4.1	5.0	5.1	5.9	6.2	5.6	6.0	6.0
4.1 ≤ E < 4.3	5.0	5.1	5.9	6.1	5.6	6.0	6.0
4.3 ≤ E < 4.5	4.9	5.0	5.9	6.0	5.5	5.9	5.9
4.5 ≤ E < 4.7	4.9	5.0	5.8	6.0	5.5	5.9	5.9
4.7 ≤ E < 4.9	4.8	5.0	5.8	6.0	5.4	5.9	5.9
E ≥ 4.9	4.8	4.9	5.7	5.9	5.4	5.8	5.8

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.7	5.9	6.9	7.1	6.4	6.9	6.9
2.7 ≤ E < 2.9	5.6	5.8	6.7	7.0	6.2	6.8	6.8
2.9 ≤ E < 3.1	5.6	5.7	6.6	6.9	6.1	6.7	6.7
3.1 ≤ E < 3.3	5.5	5.6	6.5	6.8	6.0	6.6	6.6
3.3 ≤ E < 3.5	5.4	5.5	6.4	6.7	6.0	6.6	6.5
3.5 ≤ E < 3.7	5.3	5.5	6.4	6.6	5.9	6.5	6.5
3.7 ≤ E < 3.9	5.3	5.4	6.3	6.6	5.9	6.4	6.4
3.9 ≤ E < 4.1	5.2	5.4	6.2	6.5	5.8	6.3	6.3
4.1 ≤ E < 4.3	5.1	5.3	6.1	6.4	5.8	6.3	6.2
4.3 ≤ E < 4.5	5.1	5.2	6.0	6.3	5.7	6.2	6.2
4.5 ≤ E < 4.7	5.0	5.2	6.0	6.3	5.7	6.1	6.1
4.7 ≤ E < 4.9	5.0	5.1	6.0	6.2	5.6	6.1	6.1
E ≥ 4.9	4.9	5.1	5.9	6.2	5.6	6.0	6.0

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.9	6.1	7.2	7.5	6.7	7.3	7.3
2.7 ≤ E < 2.9	5.8	6.0	7.0	7.4	6.5	7.1	7.1
2.9 ≤ E < 3.1	5.8	5.9	6.9	7.3	6.4	7.0	7.0
3.1 ≤ E < 3.3	5.7	5.8	6.8	7.1	6.3	6.9	6.9
3.3 ≤ E < 3.5	5.6	5.8	6.7	7.0	6.2	6.8	6.8
3.5 ≤ E < 3.7	5.5	5.7	6.7	6.9	6.1	6.8	6.7
3.7 ≤ E < 3.9	5.5	5.6	6.6	6.8	6.1	6.7	6.7
3.9 ≤ E < 4.1	5.4	5.6	6.5	6.8	6.0	6.6	6.6
4.1 ≤ E < 4.3	5.3	5.5	6.4	6.7	6.0	6.5	6.5
4.3 ≤ E < 4.5	5.3	5.5	6.4	6.6	5.9	6.5	6.5
4.5 ≤ E < 4.7	5.2	5.4	6.3	6.6	5.9	6.4	6.4
4.7 ≤ E < 4.9	5.2	5.3	6.2	6.5	5.8	6.4	6.4
E ≥ 4.9	5.1	5.3	6.2	6.5	5.8	6.3	6.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.2	6.4	7.6	8.0	6.9	7.7	7.7
2.7 ≤ E < 2.9	6.0	6.2	7.4	7.8	6.8	7.5	7.5
2.9 ≤ E < 3.1	6.0	6.1	7.3	7.7	6.7	7.4	7.4
3.1 ≤ E < 3.3	5.9	6.0	7.2	7.5	6.6	7.3	7.3
3.3 ≤ E < 3.5	5.8	6.0	7.0	7.4	6.5	7.1	7.1
3.5 ≤ E < 3.7	5.8	5.9	6.9	7.3	6.4	7.0	7.0
3.7 ≤ E < 3.9	5.7	5.8	6.9	7.2	6.3	7.0	7.0
3.9 ≤ E < 4.1	5.6	5.8	6.8	7.1	6.3	6.9	6.9
4.1 ≤ E < 4.3	5.5	5.7	6.7	7.0	6.2	6.8	6.8
4.3 ≤ E < 4.5	5.5	5.7	6.7	6.9	6.1	6.8	6.8
4.5 ≤ E < 4.7	5.4	5.6	6.6	6.9	6.0	6.7	6.7
4.7 ≤ E < 4.9	5.4	5.6	6.5	6.8	6.0	6.6	6.6
E ≥ 4.9	5.3	5.5	6.5	6.8	6.0	6.6	6.6

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.3	6.6	7.8	8.3	7.1	7.9	7.9
2.9 ≤ E < 3.1	6.2	6.4	7.7	8.1	7.0	7.8	7.8
3.1 ≤ E < 3.3	6.1	6.3	7.6	7.9	6.9	7.7	7.7
3.3 ≤ E < 3.5	6.0	6.2	7.4	7.8	6.8	7.5	7.5
3.5 ≤ E < 3.7	5.9	6.1	7.3	7.7	6.7	7.4	7.4
3.7 ≤ E < 3.9	5.9	6.0	7.2	7.6	6.6	7.3	7.3
3.9 ≤ E < 4.1	5.8	6.0	7.1	7.5	6.6	7.2	7.2
4.1 ≤ E < 4.3	5.7	5.9	7.0	7.4	6.5	7.1	7.1
4.3 ≤ E < 4.5	5.7	5.9	6.9	7.3	6.4	7.0	7.0
4.5 ≤ E < 4.7	5.6	5.8	6.9	7.2	6.3	7.0	7.0
4.7 ≤ E < 4.9	5.6	5.8	6.8	7.1	6.3	6.9	6.9
E ≥ 4.9	5.5	5.7	6.7	7.0	6.2	6.9	6.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.6	6.8	8.3	8.8	7.5	8.4	8.4
2.9 ≤ E < 3.1	6.5	6.7	8.1	8.6	7.4	8.2	8.2
3.1 ≤ E < 3.3	6.4	6.6	7.9	8.4	7.2	8.0	8.0
3.3 ≤ E < 3.5	6.3	6.5	7.8	8.3	7.1	7.9	7.9
3.5 ≤ E < 3.7	6.2	6.4	7.7	8.1	7.0	7.8	7.8
3.7 ≤ E < 3.9	6.1	6.3	7.6	8.0	6.9	7.7	7.7
3.9 ≤ E < 4.1	6.0	6.2	7.5	7.9	6.8	7.6	7.6
4.1 ≤ E < 4.3	5.9	6.1	7.4	7.8	6.8	7.5	7.5
4.3 ≤ E < 4.5	5.9	6.0	7.3	7.7	6.7	7.4	7.4
4.5 ≤ E < 4.7	5.8	6.0	7.2	7.6	6.6	7.3	7.3
4.7 ≤ E < 4.9	5.8	5.9	7.1	7.5	6.6	7.2	7.2
E ≥ 4.9	5.7	5.9	7.0	7.4	6.5	7.2	7.1

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	6.9	7.2	8.8	9.4	7.9	8.9	8.9
2.9 ≤ E < 3.1	6.8	7.0	8.6	9.1	7.8	8.7	8.7
3.1 ≤ E < 3.3	6.7	6.9	8.4	8.9	7.6	8.5	8.5
3.3 ≤ E < 3.5	6.6	6.8	8.3	8.8	7.5	8.4	8.4
3.5 ≤ E < 3.7	6.5	6.7	8.1	8.6	7.4	8.2	8.2
3.7 ≤ E < 3.9	6.4	6.6	8.0	8.5	7.2	8.1	8.1
3.9 ≤ E < 4.1	6.3	6.5	7.9	8.3	7.1	8.0	8.0
4.1 ≤ E < 4.3	6.2	6.4	7.7	8.2	7.0	7.9	7.9
4.3 ≤ E < 4.5	6.1	6.3	7.7	8.1	7.0	7.8	7.8
4.5 ≤ E < 4.7	6.0	6.3	7.6	8.0	6.9	7.7	7.7
4.7 ≤ E < 4.9	6.0	6.2	7.5	7.9	6.8	7.6	7.6
E ≥ 4.9	5.9	6.1	7.4	7.8	6.8	7.6	7.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.3	7.6	9.3	10.0	8.4	9.5	9.5
2.9 ≤ E < 3.1	7.1	7.4	9.1	9.8	8.2	9.2	9.2
3.1 ≤ E < 3.3	7.0	7.2	8.9	9.5	8.0	9.0	9.0
3.3 ≤ E < 3.5	6.8	7.1	8.7	9.3	7.9	8.9	8.8
3.5 ≤ E < 3.7	6.7	7.0	8.6	9.1	7.7	8.7	8.7
3.7 ≤ E < 3.9	6.6	6.9	8.4	9.0	7.6	8.6	8.6
3.9 ≤ E < 4.1	6.5	6.8	8.3	8.8	7.5	8.4	8.4
4.1 ≤ E < 4.3	6.5	6.7	8.1	8.7	7.4	8.3	8.3
4.3 ≤ E < 4.5	6.4	6.6	8.0	8.6	7.3	8.2	8.2
4.5 ≤ E < 4.7	6.3	6.5	7.9	8.5	7.2	8.1	8.1
4.7 ≤ E < 4.9	6.2	6.5	7.8	8.4	7.1	8.0	8.0
E ≥ 4.9	6.1	6.4	7.8	8.3	7.0	7.9	7.9

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.6	8.0	10.0	10.8	8.9	10.1	10.1
2.9 ≤ E < 3.1	7.5	7.8	9.7	10.4	8.7	9.9	9.8
3.1 ≤ E < 3.3	7.3	7.6	9.5	10.2	8.5	9.6	9.6
3.3 ≤ E < 3.5	7.1	7.5	9.3	9.9	8.3	9.4	9.4
3.5 ≤ E < 3.7	7.0	7.3	9.1	9.7	8.1	9.2	9.2
3.7 ≤ E < 3.9	6.9	7.2	8.9	9.6	8.0	9.0	9.0
3.9 ≤ E < 4.1	6.8	7.1	8.8	9.4	7.9	8.9	8.9
4.1 ≤ E < 4.3	6.7	7.0	8.6	9.2	7.8	8.8	8.8
4.3 ≤ E < 4.5	6.6	6.9	8.5	9.1	7.7	8.7	8.7
4.5 ≤ E < 4.7	6.6	6.8	8.4	8.9	7.6	8.6	8.5
4.7 ≤ E < 4.9	6.5	6.8	8.3	8.8	7.5	8.5	8.4
E ≥ 4.9	6.4	6.7	8.2	8.7	7.4	8.4	8.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	7.8	8.1	10.4	11.2	9.2	10.5	10.6
3.1 ≤ E < 3.3	7.7	7.9	10.1	11.0	8.9	10.3	10.3
3.3 ≤ E < 3.5	7.5	7.7	9.9	10.7	8.8	10.0	10.0
3.5 ≤ E < 3.7	7.4	7.6	9.7	10.4	8.6	9.8	9.8
3.7 ≤ E < 3.9	7.2	7.5	9.5	10.2	8.4	9.6	9.6
3.9 ≤ E < 4.1	7.1	7.3	9.3	10.0	8.3	9.5	9.4
4.1 ≤ E < 4.3	7.0	7.2	9.1	9.8	8.1	9.3	9.3
4.3 ≤ E < 4.5	6.9	7.1	9.0	9.7	8.0	9.2	9.1
4.5 ≤ E < 4.7	6.8	7.0	8.9	9.5	7.9	9.0	9.0
4.7 ≤ E < 4.9	6.7	7.0	8.8	9.4	7.8	8.9	8.9
E ≥ 4.9	6.7	6.9	8.7	9.3	7.8	8.8	8.8

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.1	8.5	11.2	12.0	9.7	11.3	11.3
3.1 ≤ E < 3.3	7.9	8.3	10.9	11.7	9.5	11.0	11.0
3.3 ≤ E < 3.5	7.8	8.1	10.6	11.4	9.3	10.8	10.7
3.5 ≤ E < 3.7	7.6	8.0	10.3	11.2	9.1	10.5	10.5
3.7 ≤ E < 3.9	7.5	7.8	10.1	10.9	8.9	10.3	10.2
3.9 ≤ E < 4.1	7.3	7.7	9.9	10.7	8.8	10.0	10.0
4.1 ≤ E < 4.3	7.2	7.6	9.7	10.5	8.6	9.9	9.9
4.3 ≤ E < 4.5	7.1	7.5	9.6	10.3	8.5	9.7	9.7
4.5 ≤ E < 4.7	7.0	7.4	9.4	10.1	8.4	9.6	9.6
4.7 ≤ E < 4.9	6.9	7.3	9.3	10.0	8.2	9.5	9.4
E ≥ 4.9	6.9	7.2	9.1	9.9	8.1	9.3	9.3
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)**						
	CE 14x14	**WE 14x14**	**WE 15x15**	**B&W 15x15**	**CE 16x16**	**WE 17x17**	**B&W 17x17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	8.6	9.0	11.9	12.6	10.4	12.0	12.0
3.1 ≤ E < 3.3	8.3	8.8	11.6	12.2	10.1	11.8	11.7
3.3 ≤ E < 3.5	8.1	8.6	11.3	11.9	9.9	11.5	11.5
3.5 ≤ E < 3.7	8.0	8.4	11.1	11.6	9.7	11.3	11.2
3.7 ≤ E < 3.9	7.8	8.3	10.8	11.4	9.5	11.0	11.0
3.9 ≤ E < 4.1	7.7	8.1	10.6	11.2	9.3	10.8	10.8
4.1 ≤ E < 4.3	7.6	8.0	10.3	11.0	9.1	10.6	10.6
4.3 ≤ E < 4.5	7.5	7.9	10.1	10.8	9.0	10.4	10.4
4.5 ≤ E < 4.7	7.4	7.7	10.0	10.6	8.8	10.2	10.2
4.7 ≤ E < 4.9	7.2	7.6	9.8	10.4	8.7	10.0	10.0
E ≥ 4.9	7.1	7.5	9.7	10.3	8.6	9.9	9.9

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	9.0	9.6	12.4	13.5	11.1	12.9	12.9
3.1 ≤ E < 3.3	8.8	9.4	12.0	13.1	10.9	12.6	12.6
3.3 ≤ E < 3.5	8.6	9.1	11.8	12.8	10.6	12.3	12.2
3.5 ≤ E < 3.7	8.4	8.9	11.5	12.5	10.3	12.0	11.9
3.7 ≤ E < 3.9	8.2	8.8	11.2	12.2	10.0	11.7	11.7
3.9 ≤ E < 4.1	8.0	8.6	11.0	11.9	9.8	11.5	11.5
4.1 ≤ E < 4.3	7.9	8.4	10.8	11.7	9.6	11.3	11.3
4.3 ≤ E < 4.5	7.8	8.2	10.6	11.5	9.5	11.1	11.1
4.5 ≤ E < 4.7	7.7	8.1	10.4	11.3	9.3	10.9	10.9
4.7 ≤ E < 4.9	7.6	8.0	10.2	11.2	9.2	10.7	10.7
E ≥ 4.9	7.5	7.9	10.0	11.0	9.0	10.6	10.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	9.6	10.2	13.3	14.4	11.8	13.8	13.8
3.1 ≤ E < 3.3	9.3	9.9	12.9	14.0	11.5	13.5	13.4
3.3 ≤ E < 3.5	9.1	9.7	12.5	13.7	11.3	13.2	13.1
3.5 ≤ E < 3.7	8.9	9.4	12.2	13.3	11.0	12.8	12.8
3.7 ≤ E < 3.9	8.7	9.2	11.9	13.0	10.7	12.5	12.5
3.9 ≤ E < 4.1	8.5	9.0	11.7	12.8	10.5	12.2	12.2
4.1 ≤ E < 4.3	8.3	8.9	11.5	12.5	10.3	12.0	12.0
4.3 ≤ E < 4.5	8.2	8.7	11.3	12.2	10.0	11.8	11.8
4.5 ≤ E < 4.7	8.0	8.6	11.1	12.0	9.9	11.6	11.6
4.7 ≤ E < 4.9	7.9	8.4	10.9	11.9	9.7	11.5	11.4
E ≥ 4.9	7.8	8.6	10.8	11.7	9.6	11.3	11.3

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	9.9	10.6	13.7	15.0	12.3	14.4	14.4
3.3 ≤ E < 3.5	9.6	10.3	13.4	14.6	11.9	14.0	14.0
3.5 ≤ E < 3.7	9.4	10.0	13.1	14.2	11.7	13.7	13.7
3.7 ≤ E < 3.9	9.2	9.8	12.8	13.9	11.5	13.4	13.4
3.9 ≤ E < 4.1	9.0	9.6	12.5	13.6	11.2	13.1	13.1
4.1 ≤ E < 4.3	8.8	9.4	12.2	13.4	11.0	12.9	12.8
4.3 ≤ E < 4.5	8.7	9.2	12.0	13.1	10.8	12.6	12.6
4.5 ≤ E < 4.7	8.5	9.1	11.8	12.9	10.6	12.4	12.3
4.7 ≤ E < 4.9	8.4	8.9	11.6	12.7	10.3	12.2	12.1
E ≥ 4.9	8.3	8.8	11.4	12.5	10.2	12.0	11.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	10.6	11.3	14.7	16.0	12.8	15.3	15.4
3.3 ≤ E < 3.5	10.2	11.0	14.3	15.6	12.4	15.0	14.9
3.5 ≤ E < 3.7	9.9	10.7	13.9	15.2	12.1	14.6	14.6
3.7 ≤ E < 3.9	9.7	10.4	13.6	14.9	11.8	14.3	14.2
3.9 ≤ E < 4.1	9.5	10.2	13.3	14.6	11.6	14.0	13.9
4.1 ≤ E < 4.3	9.3	9.9	13.0	14.3	11.4	13.7	13.7
4.3 ≤ E < 4.5	9.1	9.8	12.8	14.0	11.1	13.5	13.4
4.5 ≤ E < 4.7	8.9	9.6	12.5	13.8	10.9	13.2	13.2
4.7 ≤ E < 4.9	8.8	9.4	12.3	13.6	10.7	13.0	13.0
E ≥ 4.9	8.7	9.3	12.1	13.4	10.6	12.8	12.8

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	11.2	12.0	15.6	17.0	13.6	16.3	16.3
3.3 ≤ E < 3.5	10.9	11.7	15.2	16.6	13.3	16.0	15.9
3.5 ≤ E < 3.7	10.6	11.4	14.9	16.2	12.9	15.6	15.5
3.7 ≤ E < 3.9	10.3	11.1	14.5	15.9	12.6	15.2	15.2
3.9 ≤ E < 4.1	10.0	10.9	14.2	15.5	12.2	14.9	14.9
4.1 ≤ E < 4.3	9.8	10.6	13.8	15.2	12.0	14.6	14.6
4.3 ≤ E < 4.5	9.6	10.4	13.6	14.9	11.8	14.4	14.3
4.5 ≤ E < 4.7	9.4	10.2	13.4	14.7	11.6	14.1	14.0
4.7 ≤ E < 4.9	9.3	10.0	13.2	14.4	11.4	13.8	13.8
E ≥ 4.9	9.1	9.8	12.9	14.2	11.2	13.6	13.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	CE 14x14	WE 14x14	WE 15x15	B&W 15x15	CE 16x16	WE 17x17	B&W 17x17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	11.9	12.8	16.6	18.0	14.5	17.3	17.3
3.3 ≤ E < 3.5	11.6	12.4	16.2	17.6	14.0	16.9	16.9
3.5 ≤ E < 3.7	11.3	12.0	15.8	17.2	13.7	16.6	16.5
3.7 ≤ E < 3.9	11.0	11.8	15.5	16.8	13.4	16.2	16.2
3.9 ≤ E < 4.1	10.7	11.5	15.1	16.5	13.1	15.9	15.8
4.1 ≤ E < 4.3	10.4	11.3	14.8	16.2	12.8	15.6	15.5
4.3 ≤ E < 4.5	10.2	11.1	14.5	15.9	12.5	15.3	15.2
4.5 ≤ E < 4.7	10.0	10.9	14.2	15.6	12.3	15.0	15.0
4.7 ≤ E < 4.9	9.8	10.6	14.0	15.4	12.0	14.8	14.7
E ≥ 4.9	9.6	10.4	13.8	15.1	11.9	14.5	14.5

Table 2-15 Loading Table for PWR Fuel – 922 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	CE 14×14	WE 14×14	WE 15×15	B&W 15×15	CE 16×16	WE 17×17	B&W 17×17
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	12.6	13.6	17.6	19.0	15.4	18.3	18.3
3.3 ≤ E < 3.5	12.2	13.2	17.2	18.6	15.0	17.9	17.9
3.5 ≤ E < 3.7	11.9	12.9	16.8	18.2	14.6	17.6	17.5
3.7 ≤ E < 3.9	11.6	12.6	16.4	17.8	14.2	17.2	17.2
3.9 ≤ E < 4.1	11.3	12.2	16.0	17.5	13.9	16.9	16.8
4.1 ≤ E < 4.3	11.1	12.0	15.7	17.2	13.6	16.5	16.5
4.3 ≤ E < 4.5	10.8	11.7	15.4	16.9	13.3	16.2	16.2
4.5 ≤ E < 4.7	10.6	11.5	15.2	16.6	13.1	15.9	15.9
4.7 ≤ E < 4.9	10.4	11.3	14.9	16.3	12.8	15.7	15.6
E ≥ 4.9	10.2	11.1	14.6	16.1	12.6	15.4	15.4
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)**						
	CE 14×14	**WE 14×14**	**WE 15×15**	**B&W 15×15**	**CE 16×16**	**WE 17×17**	**B&W 17×17**
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	13.0	14.0	18.1	19.6	15.9	18.5	18.5
3.5 ≤ E < 3.7	12.6	13.7	17.7	19.2	15.5	18.1	18.0
3.7 ≤ E < 3.9	12.3	13.4	17.4	18.9	15.1	17.7	17.7
3.9 ≤ E < 4.1	12.0	13.1	17.0	18.5	14.8	17.4	17.3
4.1 ≤ E < 4.3	11.7	12.7	16.6	18.1	14.4	17.0	17.0
4.3 ≤ E < 4.5	11.5	12.4	16.3	17.9	14.1	16.7	16.7
4.5 ≤ E < 4.7	11.2	12.2	16.0	17.5	13.9	16.4	16.4
4.7 ≤ E < 4.9	11.0	11.9	15.8	17.3	13.6	16.1	16.1
E ≥ 4.9	10.8	11.8	15.5	17.1	13.4	15.9	15.8

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	4.8	4.9	5.6	5.7	5.2	5.6	5.6
2.3 ≤ E < 2.5	4.7	4.8	5.5	5.7	5.2	5.6	5.6
2.5 ≤ E < 2.7	4.7	4.8	5.4	5.6	5.1	5.5	5.5
2.7 ≤ E < 2.9	4.6	4.7	5.4	5.5	5.0	5.5	5.5
2.9 ≤ E < 3.1	4.6	4.7	5.3	5.5	5.0	5.4	5.4
3.1 ≤ E < 3.3	4.5	4.6	5.3	5.4	5.0	5.3	5.3
3.3 ≤ E < 3.5	4.5	4.6	5.2	5.4	4.9	5.3	5.3
3.5 ≤ E < 3.7	4.5	4.5	5.1	5.3	4.9	5.2	5.2
3.7 ≤ E < 3.9	4.4	4.5	5.1	5.3	4.8	5.2	5.2
3.9 ≤ E < 4.1	4.4	4.5	5.0	5.2	4.8	5.2	5.1
4.1 ≤ E < 4.3	4.4	4.4	5.0	5.2	4.8	5.1	5.1
4.3 ≤ E < 4.5	4.3	4.4	5.0	5.1	4.8	5.1	5.1
4.5 ≤ E < 4.7	4.3	4.4	5.0	5.1	4.7	5.0	5.0
4.7 ≤ E < 4.9	4.3	4.4	4.9	5.1	4.7	5.0	5.0
E ≥ 4.9	4.3	4.3	4.9	5.0	4.7	5.0	5.0
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	5.2	5.3	6.0	6.3	5.7	6.1	6.1
2.5 ≤ E < 2.7	5.1	5.2	6.0	6.2	5.7	6.0	6.0
2.7 ≤ E < 2.9	5.0	5.2	5.9	6.1	5.6	6.0	6.0
2.9 ≤ E < 3.1	5.0	5.1	5.9	6.0	5.5	5.9	5.9
3.1 ≤ E < 3.3	4.9	5.0	5.8	6.0	5.5	5.9	5.9
3.3 ≤ E < 3.5	4.9	5.0	5.8	5.9	5.4	5.8	5.8
3.5 ≤ E < 3.7	4.9	4.9	5.7	5.9	5.4	5.8	5.8
3.7 ≤ E < 3.9	4.8	4.9	5.7	5.8	5.3	5.8	5.8
3.9 ≤ E < 4.1	4.8	4.9	5.6	5.8	5.3	5.7	5.7
4.1 ≤ E < 4.3	4.7	4.8	5.6	5.8	5.2	5.7	5.7
4.3 ≤ E < 4.5	4.7	4.8	5.5	5.7	5.2	5.6	5.6
4.5 ≤ E < 4.7	4.7	4.8	5.5	5.7	5.2	5.6	5.6
4.7 ≤ E < 4.9	4.6	4.7	5.5	5.7	5.1	5.6	5.6
E ≥ 4.9	4.6	4.7	5.4	5.6	5.1	5.5	5.5

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	5.8	5.9	6.9	7.1	6.4	6.9	6.9
2.5 ≤ E < 2.7	5.7	5.8	6.8	7.0	6.3	6.8	6.8
2.7 ≤ E < 2.9	5.6	5.7	6.7	6.9	6.2	6.7	6.7
2.9 ≤ E < 3.1	5.5	5.7	6.6	6.8	6.1	6.7	6.7
3.1 ≤ E < 3.3	5.5	5.6	6.5	6.8	6.0	6.6	6.6
3.3 ≤ E < 3.5	5.4	5.5	6.4	6.7	6.0	6.5	6.5
3.5 ≤ E < 3.7	5.3	5.5	6.3	6.6	5.9	6.5	6.4
3.7 ≤ E < 3.9	5.3	5.4	6.3	6.5	5.9	6.4	6.4
3.9 ≤ E < 4.1	5.2	5.4	6.2	6.5	5.8	6.3	6.3
4.1 ≤ E < 4.3	5.2	5.3	6.1	6.4	5.8	6.3	6.3
4.3 ≤ E < 4.5	5.1	5.3	6.1	6.4	5.7	6.2	6.2
4.5 ≤ E < 4.7	5.1	5.2	6.0	6.3	5.7	6.2	6.2
4.7 ≤ E < 4.9	5.0	5.2	6.0	6.3	5.7	6.1	6.1
E ≥ 4.9	5.0	5.1	6.0	6.2	5.6	6.1	6.1
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)**						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.3	6.5	7.7	8.1	7.0	7.8	7.8
2.7 ≤ E < 2.9	6.2	6.4	7.6	8.0	6.9	7.7	7.7
2.9 ≤ E < 3.1	6.1	6.3	7.5	7.8	6.9	7.6	7.6
3.1 ≤ E < 3.3	6.0	6.2	7.4	7.7	6.8	7.4	7.4
3.3 ≤ E < 3.5	5.9	6.1	7.2	7.6	6.7	7.3	7.3
3.5 ≤ E < 3.7	5.9	6.0	7.1	7.5	6.6	7.3	7.2
3.7 ≤ E < 3.9	5.8	6.0	7.1	7.4	6.5	7.2	7.1
3.9 ≤ E < 4.1	5.8	5.9	7.0	7.4	6.5	7.1	7.1
4.1 ≤ E < 4.3	5.7	5.9	6.9	7.3	6.4	7.0	7.0
4.3 ≤ E < 4.5	5.7	5.8	6.9	7.2	6.4	7.0	7.0
4.5 ≤ E < 4.7	5.6	5.8	6.8	7.1	6.3	6.9	6.9
4.7 ≤ E < 4.9	5.6	5.7	6.8	7.1	6.3	6.9	6.9
E ≥ 4.9	5.5	5.7	6.7	7.0	6.2	6.8	6.8

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.6	6.8	8.2	8.7	7.4	8.3	8.3
2.7 ≤ E < 2.9	6.5	6.7	8.0	8.5	7.3	8.1	8.1
2.9 ≤ E < 3.1	6.4	6.6	7.9	8.3	7.2	8.0	8.0
3.1 ≤ E < 3.3	6.3	6.5	7.8	8.2	7.1	7.9	7.9
3.3 ≤ E < 3.5	6.2	6.4	7.7	8.0	7.0	7.8	7.8
3.5 ≤ E < 3.7	6.1	6.3	7.6	8.0	6.9	7.7	7.7
3.7 ≤ E < 3.9	6.0	6.2	7.5	7.9	6.8	7.6	7.6
3.9 ≤ E < 4.1	6.0	6.1	7.4	7.8	6.8	7.5	7.5
4.1 ≤ E < 4.3	5.9	6.1	7.3	7.7	6.7	7.4	7.4
4.3 ≤ E < 4.5	5.9	6.0	7.2	7.6	6.7	7.4	7.3
4.5 ≤ E < 4.7	5.8	6.0	7.1	7.6	6.6	7.3	7.3
4.7 ≤ E < 4.9	5.8	5.9	7.1	7.5	6.6	7.2	7.2
E ≥ 4.9	5.7	5.9	7.0	7.4	6.5	7.2	7.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.9	7.1	8.7	9.3	7.8	8.8	8.8
2.7 ≤ E < 2.9	6.8	7.0	8.6	9.0	7.7	8.6	8.6
2.9 ≤ E < 3.1	6.7	6.9	8.4	8.9	7.6	8.5	8.5
3.1 ≤ E < 3.3	6.6	6.8	8.2	8.7	7.5	8.3	8.3
3.3 ≤ E < 3.5	6.5	6.7	8.1	8.6	7.3	8.2	8.2
3.5 ≤ E < 3.7	6.4	6.6	8.0	8.5	7.2	8.1	8.1
3.7 ≤ E < 3.9	6.3	6.5	7.9	8.3	7.1	8.0	8.0
3.9 ≤ E < 4.1	6.2	6.5	7.8	8.2	7.1	7.9	7.9
4.1 ≤ E < 4.3	6.1	6.4	7.7	8.1	7.0	7.8	7.8
4.3 ≤ E < 4.5	6.1	6.3	7.6	8.0	6.9	7.8	7.7
4.5 ≤ E < 4.7	6.0	6.3	7.6	8.0	6.9	7.7	7.7
4.7 ≤ E < 4.9	6.0	6.2	7.5	7.9	6.8	7.6	7.6
E ≥ 4.9	5.9	6.1	7.4	7.8	6.8	7.6	7.6

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	7.3	7.5	9.3	9.9	8.3	9.4	9.4
2.7 ≤ E < 2.9	7.1	7.4	9.1	9.7	8.1	9.2	9.2
2.9 ≤ E < 3.1	7.0	7.2	8.9	9.5	8.0	9.0	9.0
3.1 ≤ E < 3.3	6.9	7.1	8.8	9.3	7.9	8.9	8.8
3.3 ≤ E < 3.5	6.8	7.0	8.6	9.2	7.8	8.7	8.7
3.5 ≤ E < 3.7	6.7	6.9	8.5	9.0	7.7	8.6	8.6
3.7 ≤ E < 3.9	6.6	6.8	8.4	8.9	7.6	8.5	8.5
3.9 ≤ E < 4.1	6.5	6.8	8.2	8.8	7.5	8.4	8.4
4.1 ≤ E < 4.3	6.5	6.7	8.1	8.7	7.4	8.3	8.3
4.3 ≤ E < 4.5	6.4	6.6	8.0	8.6	7.3	8.2	8.2
4.5 ≤ E < 4.7	6.3	6.6	8.0	8.5	7.2	8.1	8.1
4.7 ≤ E < 4.9	6.2	6.5	7.9	8.4	7.2	8.0	8.0
E ≥ 4.9	6.2	6.4	7.8	8.3	7.1	8.0	8.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	7.7	8.0	10.0	10.8	8.8	10.0	10.1
2.7 ≤ E < 2.9	7.5	7.8	9.7	10.5	8.7	9.9	9.8
2.9 ≤ E < 3.1	7.4	7.7	9.5	10.2	8.5	9.7	9.6
3.1 ≤ E < 3.3	7.2	7.5	9.3	10.0	8.3	9.5	9.4
3.3 ≤ E < 3.5	7.1	7.4	9.2	9.8	8.2	9.3	9.3
3.5 ≤ E < 3.7	7.1	7.3	9.0	9.7	8.0	9.1	9.1
3.7 ≤ E < 3.9	6.9	7.2	8.9	9.5	8.0	9.0	9.0
3.9 ≤ E < 4.1	6.8	7.1	8.8	9.4	7.9	8.9	8.9
4.1 ≤ E < 4.3	6.7	7.0	8.7	9.2	7.8	8.8	8.8
4.3 ≤ E < 4.5	6.7	6.9	8.5	9.1	7.7	8.7	8.7
4.5 ≤ E < 4.7	6.6	6.9	8.5	9.0	7.6	8.6	8.6
4.7 ≤ E < 4.9	6.6	6.8	8.4	8.9	7.6	8.5	8.5
E ≥ 4.9	6.5	6.8	8.3	8.9	7.5	8.5	8.4

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.9	8.2	10.5	11.4	9.2	10.6	10.6
2.9 ≤ E < 3.1	7.8	8.1	10.2	11.1	9.0	10.4	10.4
3.1 ≤ E < 3.3	7.6	7.9	10.0	10.8	8.8	10.1	10.1
3.3 ≤ E < 3.5	7.5	7.8	9.8	10.6	8.7	9.9	9.9
3.5 ≤ E < 3.7	7.3	7.7	9.6	10.4	8.6	9.8	9.8
3.7 ≤ E < 3.9	7.2	7.6	9.5	10.2	8.4	9.6	9.6
3.9 ≤ E < 4.1	7.1	7.5	9.3	10.0	8.3	9.5	9.5
4.1 ≤ E < 4.3	7.0	7.4	9.2	9.9	8.2	9.4	9.3
4.3 ≤ E < 4.5	7.0	7.3	9.1	9.8	8.1	9.2	9.2
4.5 ≤ E < 4.7	6.9	7.2	9.0	9.7	8.0	9.1	9.1
4.7 ≤ E < 4.9	6.8	7.1	8.9	9.6	7.9	9.0	9.0
E ≥ 4.9	6.8	7.0	8.8	9.5	7.9	9.0	8.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.4	8.8	11.3	12.1	9.8	11.4	11.4
2.9 ≤ E < 3.1	8.2	8.6	11.0	11.9	9.6	11.2	11.2
3.1 ≤ E < 3.3	8.0	8.4	10.8	11.6	9.4	10.9	10.9
3.3 ≤ E < 3.5	7.9	8.2	10.6	11.4	9.2	10.7	10.7
3.5 ≤ E < 3.7	7.7	8.1	10.3	11.2	9.0	10.5	10.5
3.7 ≤ E < 3.9	7.6	8.0	10.1	11.0	8.9	10.3	10.3
3.9 ≤ E < 4.1	7.5	7.9	10.0	10.8	8.8	10.1	10.1
4.1 ≤ E < 4.3	7.4	7.8	9.8	10.7	8.7	10.0	9.9
4.3 ≤ E < 4.5	7.3	7.7	9.7	10.5	8.6	9.9	9.9
4.5 ≤ E < 4.7	7.2	7.6	9.6	10.4	8.5	9.8	9.7
4.7 ≤ E < 4.9	7.1	7.5	9.5	10.2	8.4	9.7	9.6
E ≥ 4.9	7.1	7.4	9.4	10.1	8.3	9.6	9.5

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.9	9.4	12.1	13.2	10.6	12.3	12.3
2.9 ≤ E < 3.1	8.7	9.1	11.8	12.8	10.3	12.0	12.0
3.1 ≤ E < 3.3	8.5	8.9	11.6	12.6	10.0	11.7	11.7
3.3 ≤ E < 3.5	8.3	8.8	11.3	12.2	9.8	11.5	11.5
3.5 ≤ E < 3.7	8.2	8.6	11.1	12.0	9.7	11.3	11.3
3.7 ≤ E < 3.9	8.0	8.5	10.9	11.8	9.5	11.1	11.1
3.9 ≤ E < 4.1	7.9	8.3	10.8	11.6	9.4	10.9	10.9
4.1 ≤ E < 4.3	7.8	8.2	10.6	11.5	9.2	10.8	10.7
4.3 ≤ E < 4.5	7.7	8.1	10.4	11.3	9.1	10.6	10.6
4.5 ≤ E < 4.7	7.6	8.0	10.2	11.2	9.0	10.5	10.4
4.7 ≤ E < 4.9	7.5	7.9	10.1	11.0	8.9	10.3	10.3
E ≥ 4.9	7.4	7.8	10.0	10.9	8.8	10.2	10.2
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)**						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	9.5	10.0	13.1	14.2	11.4	13.3	13.2
2.9 ≤ E < 3.1	9.2	9.8	12.7	13.8	11.1	12.9	12.9
3.1 ≤ E < 3.3	9.0	9.5	12.4	13.5	10.8	12.6	12.6
3.3 ≤ E < 3.5	8.8	9.3	12.1	13.2	10.6	12.4	12.3
3.5 ≤ E < 3.7	8.6	9.1	11.9	13.0	10.4	12.0	12.1
3.7 ≤ E < 3.9	8.5	9.0	11.7	12.7	10.1	11.9	11.9
3.9 ≤ E < 4.1	8.3	8.8	11.5	12.5	10.0	11.7	11.7
4.1 ≤ E < 4.3	8.2	8.7	11.3	12.3	9.8	11.5	11.5
4.3 ≤ E < 4.5	8.1	8.6	11.2	12.1	9.7	11.4	11.4
4.5 ≤ E < 4.7	8.0	8.5	11.0	11.9	9.6	11.3	11.2
4.7 ≤ E < 4.9	7.9	8.3	10.9	11.8	9.5	11.1	11.1
E ≥ 4.9	7.8	8.2	10.7	11.7	9.4	11.0	11.0

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	10.1	10.8	14.0	15.3	12.1	14.2	14.2
2.9 ≤ E < 3.1	9.8	10.5	13.7	14.9	11.9	13.9	13.9
3.1 ≤ E < 3.3	9.6	10.2	13.4	14.6	11.6	13.6	13.5
3.3 ≤ E < 3.5	9.4	9.9	13.1	14.2	11.4	13.3	13.3
3.5 ≤ E < 3.7	9.1	9.7	12.8	13.9	11.2	13.1	13.0
3.7 ≤ E < 3.9	9.0	9.6	12.5	13.7	10.9	12.8	12.8
3.9 ≤ E < 4.1	8.8	9.4	12.3	13.5	10.7	12.6	12.5
4.1 ≤ E < 4.3	8.7	9.2	12.1	13.2	10.5	12.3	12.3
4.3 ≤ E < 4.5	8.6	9.1	11.9	13.0	10.4	12.1	12.1
4.5 ≤ E < 4.7	8.5	8.9	11.8	12.9	10.2	12.0	12.0
4.7 ≤ E < 4.9	8.4	8.8	11.6	12.7	10.0	11.8	11.8
E ≥ 4.9	8.2	8.7	11.5	12.5	9.9	11.7	11.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	10.5	11.0	14.7	16.0	12.8	14.9	14.9
3.1 ≤ E < 3.3	10.2	10.7	14.4	15.6	12.4	14.6	14.6
3.3 ≤ E < 3.5	10.0	10.5	14.0	15.3	12.1	14.3	14.2
3.5 ≤ E < 3.7	9.8	10.2	13.7	15.0	11.9	14.0	14.0
3.7 ≤ E < 3.9	9.6	10.0	13.5	14.7	11.6	13.7	13.7
3.9 ≤ E < 4.1	9.4	9.8	13.2	14.4	11.5	13.5	13.5
4.1 ≤ E < 4.3	9.2	9.6	13.0	14.2	11.3	13.3	13.2
4.3 ≤ E < 4.5	9.1	9.5	12.8	14.0	11.1	13.1	13.1
4.5 ≤ E < 4.7	8.9	9.3	12.6	13.8	11.0	12.9	12.9
4.7 ≤ E < 4.9	8.8	9.2	12.4	13.7	10.8	12.7	12.7
E ≥ 4.9	8.7	9.1	12.3	13.5	10.7	12.6	12.5

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.0	11.8	15.8	17.2	13.7	16.0	16.0
3.1 ≤ E < 3.3	10.7	11.5	15.4	16.8	13.4	15.7	15.6
3.3 ≤ E < 3.5	10.4	11.2	15.1	16.4	13.1	15.3	15.3
3.5 ≤ E < 3.7	10.1	10.9	14.8	16.1	12.8	15.0	15.0
3.7 ≤ E < 3.9	9.9	10.7	14.4	15.8	12.5	14.8	14.7
3.9 ≤ E < 4.1	9.7	10.5	14.2	15.5	12.2	14.5	14.4
4.1 ≤ E < 4.3	9.6	10.3	13.9	15.3	12.0	14.2	14.2
4.3 ≤ E < 4.5	9.4	10.1	13.7	15.1	11.8	14.0	13.9
4.5 ≤ E < 4.7	9.3	9.9	13.5	14.9	11.7	13.8	13.8
4.7 ≤ E < 4.9	9.1	9.8	13.4	14.6	11.5	13.6	13.6
E ≥ 4.9	9.0	9.7	13.2	14.4	11.4	13.4	13.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.7	12.6	16.9	17.9	14.7	17.2	17.1
3.1 ≤ E < 3.3	11.4	12.3	16.5	17.5	14.3	16.8	16.7
3.3 ≤ E < 3.5	11.1	11.9	16.1	17.1	14.0	16.4	16.4
3.5 ≤ E < 3.7	10.9	11.7	15.8	16.8	13.7	16.1	16.1
3.7 ≤ E < 3.9	10.6	11.5	15.5	16.5	13.4	15.8	15.8
3.9 ≤ E < 4.1	10.4	11.2	15.2	16.2	13.2	15.5	15.5
4.1 ≤ E < 4.3	10.2	11.0	15.0	15.9	12.9	15.3	15.2
4.3 ≤ E < 4.5	10.0	10.8	14.7	15.7	12.7	15.1	15.0
4.5 ≤ E < 4.7	9.8	10.6	14.5	15.5	12.5	14.8	14.8
4.7 ≤ E < 4.9	9.7	10.5	14.3	15.3	12.3	14.6	14.6
E ≥ 4.9	9.6	10.3	14.0	15.1	12.1	14.4	14.4

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	12.5	13.5	17.6	19.0	15.7	18.3	18.2
3.1 ≤ E < 3.3	12.1	13.1	17.2	18.6	15.3	17.9	17.8
3.3 ≤ E < 3.5	11.9	12.8	16.8	18.2	15.0	17.5	17.5
3.5 ≤ E < 3.7	11.6	12.5	16.4	17.9	14.6	17.2	17.2
3.7 ≤ E < 3.9	11.3	12.4	16.1	17.6	14.4	16.9	16.8
3.9 ≤ E < 4.1	11.1	12.0	15.8	17.3	14.0	16.6	16.6
4.1 ≤ E < 4.3	10.9	11.7	15.6	17.0	13.8	16.3	16.3
4.3 ≤ E < 4.5	10.7	11.5	15.3	16.8	13.6	16.1	16.0
4.5 ≤ E < 4.7	10.5	11.3	15.1	16.5	13.4	15.9	15.8
4.7 ≤ E < 4.9	10.3	11.2	14.9	16.3	13.2	15.6	15.6
E ≥ 4.9	10.2	11.0	14.7	16.1	13.0	15.4	15.4

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	13.4	14.5	18.6	20.1	16.8	19.4	19.3
3.1 ≤ E < 3.3	13.0	14.0	18.2	19.7	16.4	19.0	19.0
3.3 ≤ E < 3.5	12.6	13.7	17.8	19.4	16.0	18.7	18.6
3.5 ≤ E < 3.7	12.3	13.4	17.5	19.1	15.7	18.3	18.3
3.7 ≤ E < 3.9	12.0	13.1	17.2	18.7	15.3	18.0	17.9
3.9 ≤ E < 4.1	11.8	12.8	16.9	18.4	15.1	17.7	17.7
4.1 ≤ E < 4.3	11.6	12.5	16.6	18.1	14.8	17.4	17.4
4.3 ≤ E < 4.5	11.3	12.3	16.3	17.9	14.5	17.2	17.1
4.5 ≤ E < 4.7	11.2	12.0	16.1	17.6	14.3	16.9	16.9
4.7 ≤ E < 4.9	11.0	11.9	15.9	17.4	14.0	16.7	16.6
E ≥ 4.9	10.8	12.1	15.7	17.2	13.9	16.4	16.4

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	13.9	15.1	19.3	20.9	17.4	20.1	20.1
3.3 ≤ E < 3.5	13.5	14.7	18.9	20.5	17.1	19.8	19.7
3.5 ≤ E < 3.7	13.2	14.3	18.6	20.1	16.7	19.4	19.4
3.7 ≤ E < 3.9	12.9	14.0	18.2	19.8	16.4	19.2	19.1
3.9 ≤ E < 4.1	12.6	13.7	17.9	19.5	16.0	18.8	18.7
4.1 ≤ E < 4.3	12.3	13.4	17.6	19.2	15.7	18.5	18.5
4.3 ≤ E < 4.5	12.1	13.2	17.3	19.0	15.5	18.3	18.2
4.5 ≤ E < 4.7	11.9	13.0	17.1	18.7	15.2	18.0	18.0
4.7 ≤ E < 4.9	11.7	12.8	16.9	18.5	15.0	17.8	17.7
E ≥ 4.9	11.5	12.5	16.7	18.3	14.8	17.6	17.5

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	14.8	16.0	20.4	22.1	18.0	21.3	21.2
3.3 ≤ E < 3.5	14.4	15.6	20.0	21.7	17.6	20.9	20.9
3.5 ≤ E < 3.7	14.0	15.3	19.6	21.4	17.2	20.5	20.5
3.7 ≤ E < 3.9	13.7	14.9	19.3	21.0	16.9	20.3	20.2
3.9 ≤ E < 4.1	13.4	14.7	19.0	20.7	16.6	19.9	19.8
4.1 ≤ E < 4.3	13.2	14.3	18.7	20.4	16.3	19.6	19.6
4.3 ≤ E < 4.5	12.9	14.1	18.4	20.1	16.0	19.4	19.4
4.5 ≤ E < 4.7	12.7	13.8	18.1	19.9	15.7	19.1	19.1
4.7 ≤ E < 4.9	12.5	13.6	17.9	19.6	15.5	18.9	18.8
E ≥ 4.9	12.2	13.4	17.7	19.4	15.4	18.7	18.6

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	15.7	17.0	21.5	23.2	19.1	22.4	22.3
3.3 ≤ E < 3.5	15.3	16.6	21.1	22.8	18.7	22.0	21.9
3.5 ≤ E < 3.7	15.0	16.3	20.7	22.4	18.3	21.7	21.7
3.7 ≤ E < 3.9	14.6	15.9	20.4	22.1	17.9	21.4	21.3
3.9 ≤ E < 4.1	14.2	15.6	20.1	21.8	17.6	21.0	21.0
4.1 ≤ E < 4.3	14.0	15.3	19.7	21.5	17.3	20.7	20.7
4.3 ≤ E < 4.5	13.7	15.0	19.5	21.2	17.0	20.4	20.4
4.5 ≤ E < 4.7	13.5	14.7	19.2	21.0	16.7	20.2	20.2
4.7 ≤ E < 4.9	13.3	14.5	19.0	20.7	16.5	20.0	19.9
E ≥ 4.9	13.1	14.2	18.7	20.5	16.3	19.8	19.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	14×14 176	14×14 179	15×15 204	15×15 208	16×16 236	17×17 264 WE	17×17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	16.7	18.1	22.6	24.2	20.1	23.5	23.4
3.3 ≤ E < 3.5	16.3	17.6	22.2	23.9	19.7	23.1	23.1
3.5 ≤ E < 3.7	15.9	17.3	21.8	23.6	19.4	22.8	22.7
3.7 ≤ E < 3.9	15.5	16.9	21.5	23.2	19.0	22.5	22.4
3.9 ≤ E < 4.1	15.2	16.5	21.2	22.9	18.6	22.1	22.1
4.1 ≤ E < 4.3	14.9	16.2	20.9	22.6	18.3	21.8	21.8
4.3 ≤ E < 4.5	14.6	15.9	20.5	22.3	18.0	21.6	21.6
4.5 ≤ E < 4.7	14.3	15.6	20.3	22.0	17.7	21.3	21.3
4.7 ≤ E < 4.9	14.0	15.4	20.1	21.8	17.5	21.1	21.0
E ≥ 4.9	13.8	15.2	19.8	21.6	17.3	20.8	20.7

Table 2-16 Loading Table for PWR Fuel – 800 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	17.7	19.1	23.6	25.3	21.1	24.5	24.5
3.3 ≤ E < 3.5	17.3	18.7	23.3	25.0	20.7	24.2	24.2
3.5 ≤ E < 3.7	16.8	18.3	22.9	24.6	20.4	23.9	23.9
3.7 ≤ E < 3.9	16.4	17.9	22.6	24.3	20.0	23.6	23.5
3.9 ≤ E < 4.1	16.1	17.6	22.2	24.0	19.7	23.3	23.2
4.1 ≤ E < 4.3	15.8	17.3	21.9	23.7	19.3	23.0	22.9
4.3 ≤ E < 4.5	15.5	17.0	21.6	23.4	19.0	22.7	22.6
4.5 ≤ E < 4.7	15.2	16.7	21.4	23.2	18.8	22.4	22.4
4.7 ≤ E < 4.9	15.0	16.4	21.2	22.9	18.5	22.2	22.1
E ≥ 4.9	14.7	16.1	20.9	22.7	18.3	21.9	21.9

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	14x14 176	14x14 179	15x15 204	15x15 208	16x16 236	17x17 264 WE	17x17 264 B&W
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	18.2	19.7	24.3	26.0	21.8	24.8	24.7
3.5 ≤ E < 3.7	17.8	19.3	23.9	25.7	21.4	24.4	24.3
3.7 ≤ E < 3.9	17.4	18.9	23.6	25.4	21.1	24.1	24.0
3.9 ≤ E < 4.1	17.1	18.6	23.3	25.1	20.7	23.8	23.7
4.1 ≤ E < 4.3	16.7	18.2	23.0	24.8	20.4	23.5	23.4
4.3 ≤ E < 4.5	16.4	17.9	22.8	24.5	20.1	23.2	23.1
4.5 ≤ E < 4.7	16.1	17.6	22.4	24.2	19.8	22.9	22.9
4.7 ≤ E < 4.9	15.9	17.4	22.1	24.0	19.5	22.7	22.6
E ≥ 4.9	15.6	17.1	21.9	23.7	19.3	22.5	22.4

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	30 < Assembly Average Burnup ≤ 32.5 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	4.3	4.6	4.0	4.5	4.0	4.5	4.4
2.3 ≤ E < 2.5	4.2	4.6	4.0	4.5	4.0	4.4	4.4
2.5 ≤ E < 2.7	4.2	4.5	4.0	4.4	4.0	4.4	4.3
2.7 ≤ E < 2.9	4.1	4.5	4.0	4.4	4.0	4.3	4.3
2.9 ≤ E < 3.1	4.1	4.4	4.0	4.3	4.0	4.3	4.2
3.1 ≤ E < 3.3	4.0	4.4	4.0	4.3	4.0	4.2	4.2
3.3 ≤ E < 3.5	4.0	4.3	4.0	4.2	4.0	4.2	4.1
3.5 ≤ E < 3.7	4.0	4.3	4.0	4.2	4.0	4.2	4.1
3.7 ≤ E < 3.9	4.0	4.3	4.0	4.2	4.0	4.1	4.0
3.9 ≤ E < 4.1	4.0	4.2	4.0	4.1	4.0	4.1	4.0
4.1 ≤ E < 4.3	4.0	4.2	4.0	4.1	4.0	4.1	4.0
4.3 ≤ E < 4.5	4.0	4.2	4.0	4.1	4.0	4.0	4.0
4.5 ≤ E < 4.7	4.0	4.1	4.0	4.0	4.0	4.0	4.0
4.7 ≤ E < 4.9	4.0	4.1	4.0	4.0	4.0	4.0	4.0
E ≥ 4.9	4.0	4.1	4.0	4.0	4.0	4.0	4.0

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	32.5 < Assembly Average Burnup ≤ 35 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	4.7	5.0	4.3	4.9	4.0	4.9	4.8
2.5 ≤ E < 2.7	4.6	4.9	4.3	4.8	4.0	4.8	4.7
2.7 ≤ E < 2.9	4.5	4.9	4.2	4.8	4.0	4.7	4.6
2.9 ≤ E < 3.1	4.5	4.8	4.2	4.7	4.0	4.7	4.6
3.1 ≤ E < 3.3	4.4	4.8	4.1	4.7	4.0	4.6	4.5
3.3 ≤ E < 3.5	4.4	4.7	4.0	4.6	4.0	4.6	4.5
3.5 ≤ E < 3.7	4.3	4.7	4.0	4.6	4.0	4.5	4.5
3.7 ≤ E < 3.9	4.3	4.6	4.0	4.5	4.0	4.5	4.4
3.9 ≤ E < 4.1	4.2	4.6	4.0	4.5	4.0	4.5	4.4
4.1 ≤ E < 4.3	4.2	4.5	4.0	4.5	4.0	4.4	4.3
4.3 ≤ E < 4.5	4.2	4.5	4.0	4.4	4.0	4.4	4.3
4.5 ≤ E < 4.7	4.1	4.5	4.0	4.4	4.0	4.4	4.3
4.7 ≤ E < 4.9	4.1	4.5	4.0	4.4	4.0	4.3	4.2
E ≥ 4.9	4.1	4.4	4.0	4.3	4.0	4.3	4.2

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	35 < Assembly Average Burnup ≤ 37.5 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	5.2	5.6	4.7	5.4	4.4	5.4	5.2
2.5 ≤ E < 2.7	5.1	5.5	4.7	5.3	4.3	5.3	5.2
2.7 ≤ E < 2.9	5.0	5.4	4.6	5.3	4.3	5.2	5.1
2.9 ≤ E < 3.1	4.9	5.4	4.5	5.2	4.2	5.1	5.0
3.1 ≤ E < 3.3	4.9	5.3	4.5	5.1	4.1	5.1	4.9
3.3 ≤ E < 3.5	4.8	5.2	4.4	5.0	4.1	5.0	4.9
3.5 ≤ E < 3.7	4.8	5.1	4.4	5.0	4.0	4.9	4.8
3.7 ≤ E < 3.9	4.7	5.1	4.3	4.9	4.0	4.9	4.8
3.9 ≤ E < 4.1	4.6	5.0	4.3	4.9	4.0	4.9	4.7
4.1 ≤ E < 4.3	4.6	5.0	4.3	4.9	4.0	4.8	4.7
4.3 ≤ E < 4.5	4.6	4.9	4.2	4.8	4.0	4.8	4.7
4.5 ≤ E < 4.7	4.5	4.9	4.2	4.8	4.0	4.7	4.6
4.7 ≤ E < 4.9	4.5	4.9	4.1	4.7	4.0	4.7	4.6
E ≥ 4.9	4.5	4.9	4.1	4.7	4.0	4.7	4.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	37.5 < Assembly Average Burnup ≤ 40 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	5.7	6.1	5.2	5.9	4.7	5.9	5.7
2.7 ≤ E < 2.9	5.6	6.0	5.1	5.8	4.6	5.8	5.7
2.9 ≤ E < 3.1	5.5	5.9	5.0	5.8	4.6	5.7	5.6
3.1 ≤ E < 3.3	5.5	5.9	4.9	5.7	4.5	5.6	5.5
3.3 ≤ E < 3.5	5.4	5.8	4.9	5.6	4.4	5.6	5.4
3.5 ≤ E < 3.7	5.3	5.7	4.8	5.6	4.4	5.5	5.4
3.7 ≤ E < 3.9	5.2	5.7	4.7	5.5	4.3	5.4	5.3
3.9 ≤ E < 4.1	5.2	5.6	4.7	5.4	4.3	5.4	5.2
4.1 ≤ E < 4.3	5.1	5.6	4.6	5.4	4.3	5.3	5.2
4.3 ≤ E < 4.5	5.0	5.5	4.6	5.3	4.2	5.3	5.1
4.5 ≤ E < 4.7	5.0	5.5	4.5	5.3	4.2	5.2	5.0
4.7 ≤ E < 4.9	5.0	5.4	4.5	5.2	4.1	5.2	5.0
E ≥ 4.9	4.9	5.4	4.5	5.2	4.1	5.1	5.0

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	40 < Assembly Average Burnup ≤ 41 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.0	6.5	5.4	6.2	4.9	6.1	6.0
2.7 ≤ E < 2.9	5.9	6.4	5.3	6.1	4.8	6.0	5.9
2.9 ≤ E < 3.1	5.8	6.2	5.2	6.0	4.7	5.9	5.8
3.1 ≤ E < 3.3	5.7	6.1	5.1	5.9	4.7	5.9	5.7
3.3 ≤ E < 3.5	5.6	6.0	5.0	5.9	4.6	5.8	5.6
3.5 ≤ E < 3.7	5.5	6.0	5.0	5.8	4.5	5.7	5.6
3.7 ≤ E < 3.9	5.5	5.9	4.9	5.7	4.5	5.7	5.5
3.9 ≤ E < 4.1	5.4	5.9	4.9	5.7	4.4	5.6	5.5
4.1 ≤ E < 4.3	5.3	5.8	4.8	5.6	4.4	5.5	5.4
4.3 ≤ E < 4.5	5.3	5.8	4.8	5.6	4.4	5.5	5.3
4.5 ≤ E < 4.7	5.2	5.7	4.7	5.5	4.3	5.4	5.3
4.7 ≤ E < 4.9	5.2	5.7	4.7	5.5	4.3	5.4	5.2
E ≥ 4.9	5.1	5.6	4.6	5.4	4.2	5.4	5.2

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	41 < Assembly Average Burnup ≤ 42 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.3	6.8	5.6	6.5	5.1	6.4	6.2
2.7 ≤ E < 2.9	6.2	6.7	5.5	6.4	5.0	6.3	6.1
2.9 ≤ E < 3.1	6.0	6.6	5.5	6.3	4.9	6.2	6.0
3.1 ≤ E < 3.3	6.0	6.5	5.4	6.2	4.8	6.1	5.9
3.3 ≤ E < 3.5	5.9	6.4	5.3	6.1	4.8	6.0	5.9
3.5 ≤ E < 3.7	5.8	6.3	5.2	6.0	4.7	5.9	5.8
3.7 ≤ E < 3.9	5.7	6.2	5.1	5.9	4.6	5.9	5.7
3.9 ≤ E < 4.1	5.6	6.1	5.0	5.9	4.6	5.8	5.7
4.1 ≤ E < 4.3	5.6	6.0	5.0	5.8	4.5	5.8	5.6
4.3 ≤ E < 4.5	5.5	6.0	4.9	5.8	4.5	5.7	5.6
4.5 ≤ E < 4.7	5.5	5.9	4.9	5.7	4.5	5.7	5.5
4.7 ≤ E < 4.9	5.4	5.9	4.9	5.7	4.4	5.6	5.5
E ≥ 4.9	5.4	5.8	4.8	5.6	4.4	5.6	5.4

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	42 < Assembly Average Burnup ≤ 43 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	6.6	7.1	5.9	6.8	5.3	6.8	6.6
2.7 ≤ E < 2.9	6.5	7.0	5.8	6.7	5.2	6.6	6.4
2.9 ≤ E < 3.1	6.4	6.9	5.7	6.6	5.1	6.5	6.3
3.1 ≤ E < 3.3	6.3	6.8	5.6	6.5	5.0	6.4	6.2
3.3 ≤ E < 3.5	6.1	6.7	5.5	6.4	4.9	6.3	6.1
3.5 ≤ E < 3.7	6.0	6.6	5.4	6.3	4.9	6.2	6.0
3.7 ≤ E < 3.9	6.0	6.5	5.4	6.2	4.8	6.1	5.9
3.9 ≤ E < 4.1	5.9	6.4	5.3	6.1	4.8	6.0	5.9
4.1 ≤ E < 4.3	5.8	6.3	5.2	6.0	4.7	6.0	5.8
4.3 ≤ E < 4.5	5.8	6.3	5.1	6.0	4.6	5.9	5.8
4.5 ≤ E < 4.7	5.7	6.2	5.1	6.0	4.6	5.9	5.7
4.7 ≤ E < 4.9	5.7	6.1	5.0	5.9	4.6	5.9	5.7
E ≥ 4.9	5.6	6.1	5.0	5.9	4.5	5.8	5.6
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	**43 < Assembly Average Burnup ≤ 44 GWd/MTU Minimum Cooling Time (years)**						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	7.0	7.6	6.1	7.2	5.5	7.1	6.9
2.7 ≤ E < 2.9	6.8	7.4	6.0	7.0	5.4	6.9	6.7
2.9 ≤ E < 3.1	6.7	7.3	5.9	6.9	5.3	6.8	6.6
3.1 ≤ E < 3.3	6.6	7.1	5.8	6.8	5.2	6.7	6.5
3.3 ≤ E < 3.5	6.5	7.0	5.7	6.7	5.1	6.6	6.4
3.5 ≤ E < 3.7	6.4	6.9	5.7	6.6	5.0	6.5	6.3
3.7 ≤ E < 3.9	6.3	6.8	5.6	6.5	5.0	6.5	6.2
3.9 ≤ E < 4.1	6.2	6.7	5.5	6.4	4.9	6.4	6.1
4.1 ≤ E < 4.3	6.1	6.7	5.5	6.4	4.9	6.3	6.0
4.3 ≤ E < 4.5	6.0	6.6	5.4	6.3	4.8	6.2	6.0
4.5 ≤ E < 4.7	5.9	6.5	5.3	6.2	4.8	6.1	5.9
4.7 ≤ E < 4.9	5.9	6.5	5.3	6.2	4.7	6.1	5.9
E ≥ 4.9	5.8	6.4	5.2	6.1	4.7	6.0	5.9

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	44 < Assembly Average Burnup ≤ 45 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.2	7.9	6.3	7.5	5.6	7.4	7.1
2.9 ≤ E < 3.1	7.0	7.7	6.2	7.3	5.5	7.2	6.9
3.1 ≤ E < 3.3	6.9	7.6	6.1	7.1	5.4	7.0	6.8
3.3 ≤ E < 3.5	6.8	7.4	6.0	7.0	5.4	6.9	6.7
3.5 ≤ E < 3.7	6.7	7.3	5.9	6.9	5.3	6.9	6.6
3.7 ≤ E < 3.9	6.6	7.2	5.8	6.8	5.2	6.8	6.5
3.9 ≤ E < 4.1	6.5	7.1	5.8	6.8	5.1	6.7	6.4
4.1 ≤ E < 4.3	6.4	7.0	5.7	6.7	5.0	6.6	6.3
4.3 ≤ E < 4.5	6.3	6.9	5.6	6.6	5.0	6.5	6.3
4.5 ≤ E < 4.7	6.3	6.8	5.6	6.5	4.9	6.4	6.2
4.7 ≤ E < 4.9	6.2	6.8	5.5	6.5	4.9	6.4	6.1
E ≥ 4.9	6.1	6.7	5.4	6.4	4.8	6.3	6.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	45 < Assembly Average Burnup ≤ 46 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	7.7	8.3	6.7	7.9	5.9	7.8	7.5
2.9 ≤ E < 3.1	7.5	8.1	6.5	7.7	5.8	7.6	7.3
3.1 ≤ E < 3.3	7.3	8.0	6.4	7.6	5.7	7.5	7.1
3.3 ≤ E < 3.5	7.2	7.8	6.3	7.4	5.6	7.3	7.0
3.5 ≤ E < 3.7	7.0	7.7	6.1	7.3	5.5	7.2	6.9
3.7 ≤ E < 3.9	6.9	7.6	6.0	7.2	5.4	7.0	6.8
3.9 ≤ E < 4.1	6.8	7.5	6.0	7.1	5.3	7.0	6.7
4.1 ≤ E < 4.3	6.7	7.4	5.9	7.0	5.3	6.9	6.7
4.3 ≤ E < 4.5	6.7	7.3	5.8	6.9	5.2	6.8	6.6
4.5 ≤ E < 4.7	6.6	7.2	5.8	6.8	5.1	6.7	6.5
4.7 ≤ E < 4.9	6.5	7.1	5.7	6.8	5.1	6.7	6.4
E ≥ 4.9	6.4	7.0	5.7	6.7	5.0	6.6	6.4

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	46 < Assembly Average Burnup ≤ 47 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.1	8.9	7.0	8.4	6.1	8.2	7.9
2.9 ≤ E < 3.1	8.0	8.7	6.8	8.2	6.0	8.0	7.7
3.1 ≤ E < 3.3	7.8	8.5	6.7	8.0	5.9	7.9	7.6
3.3 ≤ E < 3.5	7.6	8.3	6.6	7.8	5.8	7.7	7.4
3.5 ≤ E < 3.7	7.5	8.1	6.5	7.7	5.7	7.6	7.3
3.7 ≤ E < 3.9	7.3	8.0	6.4	7.6	5.6	7.5	7.2
3.9 ≤ E < 4.1	7.2	7.9	6.3	7.5	5.5	7.4	7.0
4.1 ≤ E < 4.3	7.1	7.8	6.2	7.4	5.5	7.2	7.0
4.3 ≤ E < 4.5	7.0	7.7	6.1	7.2	5.4	7.1	6.9
4.5 ≤ E < 4.7	6.9	7.6	6.0	7.2	5.3	7.0	6.8
4.7 ≤ E < 4.9	6.8	7.5	5.9	7.1	5.3	7.0	6.7
E ≥ 4.9	6.8	7.4	5.9	7.0	5.2	6.9	6.7

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	47 < Assembly Average Burnup ≤ 48 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	8.7	9.5	7.4	8.9	6.4	8.7	8.3
2.9 ≤ E < 3.1	8.4	9.2	7.2	8.7	6.3	8.5	8.1
3.1 ≤ E < 3.3	8.2	9.0	7.0	8.5	6.1	8.3	7.9
3.3 ≤ E < 3.5	8.0	8.8	6.9	8.3	6.0	8.2	7.8
3.5 ≤ E < 3.7	7.9	8.7	6.8	8.1	5.9	8.0	7.7
3.7 ≤ E < 3.9	7.8	8.5	6.7	8.0	5.8	7.9	7.6
3.9 ≤ E < 4.1	7.6	8.3	6.6	7.9	5.8	7.8	7.4
4.1 ≤ E < 4.3	7.5	8.2	6.5	7.8	5.7	7.7	7.3
4.3 ≤ E < 4.5	7.4	8.1	6.4	7.7	5.6	7.6	7.2
4.5 ≤ E < 4.7	7.3	8.0	6.3	7.6	5.6	7.5	7.1
4.7 ≤ E < 4.9	7.2	7.9	6.2	7.5	5.5	7.4	7.0
E ≥ 4.9	7.1	7.8	6.1	7.4	5.4	7.3	7.0

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	48 < Assembly Average Burnup ≤ 49 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	9.3	10.1	7.8	9.5	6.7	9.3	8.8
2.9 ≤ E < 3.1	9.0	9.9	7.6	9.2	6.6	9.0	8.7
3.1 ≤ E < 3.3	8.8	9.6	7.4	9.0	6.4	8.9	8.4
3.3 ≤ E < 3.5	8.6	9.4	7.3	8.8	6.3	8.7	8.2
3.5 ≤ E < 3.7	8.4	9.2	7.1	8.6	6.2	8.5	8.1
3.7 ≤ E < 3.9	8.3	9.0	7.0	8.5	6.1	8.3	7.9
3.9 ≤ E < 4.1	8.1	8.9	6.9	8.3	6.0	8.2	7.8
4.1 ≤ E < 4.3	8.0	8.7	6.8	8.2	5.9	8.1	7.7
4.3 ≤ E < 4.5	7.8	8.6	6.7	8.0	5.8	7.9	7.6
4.5 ≤ E < 4.7	7.7	8.5	6.6	8.0	5.8	7.9	7.5
4.7 ≤ E < 4.9	7.6	8.4	6.5	7.9	5.7	7.8	7.4
E ≥ 4.9	7.5	8.2	6.5	7.8	5.6	7.7	7.4
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	49 < Assembly Average Burnup ≤ 50 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	9.6	10.6	8.0	9.8	6.9	9.7	9.2
3.1 ≤ E < 3.3	9.4	10.3	7.8	9.6	6.7	9.4	8.9
3.3 ≤ E < 3.5	9.2	10.0	7.7	9.4	6.6	9.2	8.8
3.5 ≤ E < 3.7	8.9	9.8	7.5	9.2	6.5	9.0	8.6
3.7 ≤ E < 3.9	8.8	9.6	7.4	9.0	6.4	8.8	8.4
3.9 ≤ E < 4.1	8.6	9.5	7.3	8.9	6.3	8.7	8.3
4.1 ≤ E < 4.3	8.4	9.3	7.1	8.7	6.1	8.6	8.1
4.3 ≤ E < 4.5	8.3	9.1	7.0	8.6	6.0	8.4	8.0
4.5 ≤ E < 4.7	8.1	9.0	6.9	8.5	6.0	8.3	7.9
4.7 ≤ E < 4.9	8.0	8.9	6.8	8.3	5.9	8.2	7.8
E ≥ 4.9	7.9	8.8	6.8	8.2	5.9	8.1	7.7

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	50 < Assembly Average Burnup ≤ 51 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	10.4	11.4	8.6	10.6	7.2	10.3	9.7
3.1 ≤ E < 3.3	10.0	11.1	8.4	10.3	7.0	10.0	9.6
3.3 ≤ E < 3.5	9.8	10.8	8.1	10.0	6.9	9.8	9.3
3.5 ≤ E < 3.7	9.5	10.5	8.0	9.7	6.8	9.6	9.0
3.7 ≤ E < 3.9	9.3	10.3	7.8	9.5	6.6	9.4	8.9
3.9 ≤ E < 4.1	9.1	10.0	7.7	9.4	6.6	9.2	8.8
4.1 ≤ E < 4.3	9.0	9.8	7.5	9.2	6.5	9.1	8.6
4.3 ≤ E < 4.5	8.8	9.7	7.4	9.0	6.3	8.9	8.5
4.5 ≤ E < 4.7	8.7	9.6	7.3	8.9	6.3	8.8	8.4
4.7 ≤ E < 4.9	8.5	9.4	7.2	8.8	6.2	8.7	8.2
E ≥ 4.9	8.4	9.3	7.1	8.7	6.1	8.6	8.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	51 < Assembly Average Burnup ≤ 52 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.1	12.1	9.1	11.3	7.6	11.1	10.5
3.1 ≤ E < 3.3	10.8	11.8	8.9	11.0	7.4	10.8	10.2
3.3 ≤ E < 3.5	10.5	11.6	8.6	10.7	7.3	10.5	9.9
3.5 ≤ E < 3.7	10.2	11.2	8.4	10.4	7.1	10.2	9.7
3.7 ≤ E < 3.9	10.0	11.1	8.3	10.2	7.0	10.0	9.4
3.9 ≤ E < 4.1	9.8	10.8	8.1	10.0	6.8	9.8	9.3
4.1 ≤ E < 4.3	9.6	10.6	7.9	9.8	6.7	9.6	9.1
4.3 ≤ E < 4.5	9.4	10.3	7.8	9.6	6.6	9.5	9.0
4.5 ≤ E < 4.7	9.2	10.2	7.7	9.5	6.5	9.3	8.8
4.7 ≤ E < 4.9	9.1	10.1	7.6	9.4	6.5	9.2	8.7
E ≥ 4.9	8.9	9.9	7.5	9.2	6.4	9.0	8.6

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	52 < Assembly Average Burnup ≤ 53 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	11.9	13.0	9.6	12.0	8.0	11.8	11.2
3.1 ≤ E < 3.3	11.5	12.7	9.4	11.7	7.8	11.5	10.9
3.3 ≤ E < 3.5	11.2	12.4	9.1	11.4	7.6	11.2	10.6
3.5 ≤ E < 3.7	11.0	12.0	8.9	11.1	7.5	10.9	10.3
3.7 ≤ E < 3.9	10.7	11.7	8.7	10.9	7.3	10.7	10.0
3.9 ≤ E < 4.1	10.4	11.5	8.6	10.7	7.2	10.5	9.9
4.1 ≤ E < 4.3	10.2	11.3	8.4	10.5	7.0	10.3	9.7
4.3 ≤ E < 4.5	10.0	11.1	8.2	10.3	6.9	10.0	9.5
4.5 ≤ E < 4.7	9.8	10.9	8.1	10.1	6.8	9.9	9.4
4.7 ≤ E < 4.9	9.7	10.7	8.0	10.0	6.7	9.8	9.2
E ≥ 4.9	9.5	10.6	7.9	9.8	6.7	9.6	9.1

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	53 < Assembly Average Burnup ≤ 54 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	12.7	13.8	10.4	12.9	8.5	12.6	11.9
3.1 ≤ E < 3.3	12.3	13.6	10.0	12.6	8.3	12.3	11.6
3.3 ≤ E < 3.5	11.9	13.2	9.8	12.1	8.0	11.9	11.3
3.5 ≤ E < 3.7	11.6	12.9	9.5	11.9	7.9	11.7	11.0
3.7 ≤ E < 3.9	11.4	12.6	9.2	11.7	7.7	11.4	10.7
3.9 ≤ E < 4.1	11.2	12.3	9.0	11.4	7.5	11.2	10.6
4.1 ≤ E < 4.3	11.0	12.0	8.9	11.2	7.4	11.0	10.3
4.3 ≤ E < 4.5	10.8	11.8	8.7	11.0	7.3	10.8	10.0
4.5 ≤ E < 4.7	10.5	11.6	8.6	10.8	7.1	10.6	9.9
4.7 ≤ E < 4.9	10.3	11.5	8.4	10.6	7.0	10.4	9.8
E ≥ 4.9	10.2	11.3	8.3	10.5	7.0	10.2	9.6

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	54 < Assembly Average Burnup ≤ 55 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	13.2	14.4	10.7	13.4	8.7	13.1	12.4
3.3 ≤ E < 3.5	12.8	14.1	10.4	13.1	8.5	12.8	11.9
3.5 ≤ E < 3.7	12.5	13.7	10.0	12.7	8.3	12.5	11.7
3.7 ≤ E < 3.9	12.2	13.4	9.9	12.4	8.1	12.2	11.5
3.9 ≤ E < 4.1	11.9	13.2	9.7	12.1	7.9	11.9	11.2
4.1 ≤ E < 4.3	11.6	12.8	9.4	11.9	7.8	11.7	11.0
4.3 ≤ E < 4.5	11.5	12.7	9.3	11.7	7.6	11.5	10.8
4.5 ≤ E < 4.7	11.2	12.4	9.0	11.5	7.5	11.3	10.6
4.7 ≤ E < 4.9	11.1	12.2	8.9	11.3	7.4	11.1	10.4
E ≥ 4.9	10.9	12.0	8.8	11.2	7.3	10.9	10.3

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	55 < Assembly Average Burnup ≤ 56 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	13.9	15.4	11.4	14.2	9.2	14.0	13.2
3.3 ≤ E < 3.5	13.6	15.0	11.1	13.9	9.0	13.6	12.9
3.5 ≤ E < 3.7	13.2	14.7	10.8	13.5	8.8	13.3	12.5
3.7 ≤ E < 3.9	12.8	14.3	10.5	13.2	8.5	13.0	12.1
3.9 ≤ E < 4.1	12.5	14.0	10.3	13.0	8.3	12.8	11.9
4.1 ≤ E < 4.3	12.3	13.7	10.0	12.7	8.2	12.5	11.7
4.3 ≤ E < 4.5	12.1	13.5	9.8	12.5	8.0	12.2	11.5
4.5 ≤ E < 4.7	11.9	13.2	9.6	12.2	7.9	12.0	11.3
4.7 ≤ E < 4.9	11.6	13.0	9.5	12.0	7.8	11.8	11.1
E ≥ 4.9	11.5	12.8	9.3	11.8	7.7	11.6	10.9

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	56 < Assembly Average Burnup ≤ 57 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	14.8	16.3	12.2	15.2	9.8	14.9	14.0
3.3 ≤ E < 3.5	14.5	16.0	11.8	14.8	9.5	14.5	13.6
3.5 ≤ E < 3.7	14.1	15.6	11.5	14.4	9.2	14.1	13.4
3.7 ≤ E < 3.9	13.7	15.2	11.3	14.1	9.0	13.8	13.0
3.9 ≤ E < 4.1	13.5	14.9	11.0	13.8	8.8	13.5	12.7
4.1 ≤ E < 4.3	13.2	14.6	10.7	13.5	8.6	13.2	12.4
4.3 ≤ E < 4.5	12.9	14.3	10.5	13.3	8.5	12.9	12.2
4.5 ≤ E < 4.7	12.7	14.1	10.3	13.0	8.3	12.7	12.0
4.7 ≤ E < 4.9	12.4	13.9	10.0	12.8	8.1	12.6	11.7
E ≥ 4.9	12.2	13.7	9.9	12.6	8.0	12.4	11.6

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	57 < Assembly Average Burnup ≤ 58 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	15.7	17.3	13.0	16.1	10.5	15.9	14.9
3.3 ≤ E < 3.5	15.3	17.0	12.6	15.7	10.1	15.4	14.5
3.5 ≤ E < 3.7	15.0	16.5	12.3	15.3	9.8	15.1	14.2
3.7 ≤ E < 3.9	14.6	16.1	11.9	15.0	9.6	14.7	13.8
3.9 ≤ E < 4.1	14.3	15.9	11.6	14.6	9.3	14.4	13.5
4.1 ≤ E < 4.3	13.9	15.5	11.4	14.3	9.1	14.0	13.3
4.3 ≤ E < 4.5	13.7	15.2	11.2	14.1	8.9	13.9	13.0
4.5 ≤ E < 4.7	13.5	15.0	10.9	13.9	8.8	13.6	12.7
4.7 ≤ E < 4.9	13.2	14.7	10.7	13.7	8.6	13.3	12.5
E ≥ 4.9	12.9	14.5	10.5	13.4	8.5	13.1	12.3

Table 2-17 Loading Table for BWR Fuel – 379 W/Assembly (continued)

Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	58 < Assembly Average Burnup ≤ 59 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	16.7	18.3	13.8	17.1	11.1	16.8	15.8
3.3 ≤ E < 3.5	16.2	17.9	13.4	16.6	10.8	16.3	15.4
3.5 ≤ E < 3.7	15.8	17.5	13.1	16.3	10.4	16.0	15.0
3.7 ≤ E < 3.9	15.5	17.1	12.7	15.9	10.2	15.6	14.6
3.9 ≤ E < 4.1	15.2	16.8	12.4	15.6	9.9	15.3	14.4
4.1 ≤ E < 4.3	14.9	16.5	12.0	15.3	9.7	15.0	14.0
4.3 ≤ E < 4.5	14.6	16.2	11.8	15.0	9.4	14.7	13.7
4.5 ≤ E < 4.7	14.3	15.9	11.6	14.7	9.3	14.4	13.5
4.7 ≤ E < 4.9	14.0	15.6	11.4	14.4	9.0	14.2	13.3
E ≥ 4.9	13.8	15.4	11.2	14.2	8.9	14.0	13.1
Minimum Initial Assembly Avg. Enrichment wt % ^{235}U (E)	59 < Assembly Average Burnup ≤ 60 GWd/MTU Minimum Cooling Time (years)						
	BWR/2-3 7×7	BWR/4-6 7×7	BWR/2-3 8×8	BWR/4-6 8×8	BWR/2-3 9×9	BWR/4-6 9×9	BWR/4-6 10×10
2.1 ≤ E < 2.3	-	-	-	-	-	-	-
2.3 ≤ E < 2.5	-	-	-	-	-	-	-
2.5 ≤ E < 2.7	-	-	-	-	-	-	-
2.7 ≤ E < 2.9	-	-	-	-	-	-	-
2.9 ≤ E < 3.1	-	-	-	-	-	-	-
3.1 ≤ E < 3.3	-	-	-	-	-	-	-
3.3 ≤ E < 3.5	17.2	18.8	14.1	17.5	11.4	17.3	16.4
3.5 ≤ E < 3.7	16.8	18.5	13.7	17.2	11.1	17.0	15.9
3.7 ≤ E < 3.9	16.5	18.1	13.4	16.9	10.8	16.5	15.5
3.9 ≤ E < 4.1	16.0	17.7	13.0	16.4	10.5	16.2	15.2
4.1 ≤ E < 4.3	15.7	17.4	12.7	16.1	10.2	15.9	14.9
4.3 ≤ E < 4.5	15.4	17.1	12.5	15.9	10.0	15.6	14.6
4.5 ≤ E < 4.7	15.1	16.8	12.2	15.6	9.8	15.3	14.4
4.7 ≤ E < 4.9	14.9	16.5	11.9	15.3	9.6	15.1	14.0
E ≥ 4.9	14.7	16.3	11.7	15.1	9.4	14.8	13.8